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ON THE COMPARATIVE ECONOMY OF CONDENSING AND NON-CONDENSING ENGINES.

That steam may be used in an ordinary non-condensing engine, of such an elasticity as shall make it fully equal in economy of fuel to the low-pressure condensing engine commonly employed in English practice, has long been believed by many engineers, both scientific and practical, to be a point that can be easily proved.

The writer records his own adherence to this belief, notwithstanding it involves a supposed law upon the pressure and density of steam greatly at variance with the opinions of several eminent writers upon the steam-engine. Thus, according to Dr. Lardner, from whom we take the following extract, it would seem to be immaterial in what manner, or in what kind of engine, steam is used, and that all experiments and research to determine in what way to realize the greatest mechanical effect therefrom have been entirely useless.

"The same quantity of water being converted into steam, produces the same mechanical effect, whatever be the *pressure* or *density* of the steam."—*Vide Dr. Lardner on the Steam-Engine, p.* 279, *American ed.*

But the opinions of this author are sometimes fallible;—witness his arguments respecting the practicability of establishing a regular communication by the power of steam between Great Britain and the United States, which have been proved erroneous

by more than two years experience; and we shall venture to assert that he greatly errs in the above statement—appealing, as we confidently can, to the experience of almost every practical engineer to sustain the assertion.

To return, however, to that particular application of steam which is most immediately the subject of this paper. We shall endeavor to show that there *is* a pressure at which, if a non-condensing engine be worked, it will, for a given mechanical effect, equal in economy in the consumption of fuel the low-pressure condensing engine of the English practice, and that this pressure is safely and with certainty attainable.

In treating of the density and pressure of steam relatively to each other, the subject has become so mystified and obscured by the contradictory statements of different authors, that the practical engineer is at a loss in what manner to understand the ratio of increase, or what reason to assign for it. That this is the case, is shown by the extracts which follow, taken from the works of several writers upon the steam-engine.

"And they also show that the bulk or volume of steam is *inversely as the pressure*, when the temperature is not altered; and conversely the *density is directly as the pressure*."—*Vide Tredgold, Woodhouse's edition, p.* 52.

"That the bulk which steam fills is diminished in the same proportion as the pressure of the steam is increased; or, in other words, that the *density* of steam is always in the *same proportion* as its *pressure*."—*Lardner upon the Steam-Engine, p.* 279, *American edition.*

"It may likewise be remarked that the variation of the density or specific gravity of steam is only *strictly proportional* to its pressure or elasticity when the temperatures are the same."—*R. Wallace's Practical Mechanic's Pocket Guide, p.* 43.

"This arises from the fact that the density of steam increases *nearly* as fast as the pressure under which it is generated. Did both increase in the *same* ratio, there would be nothing gained by the use of high steam."—*Renwick on the Steam-Engine, p.* 162, *new edition.*

In addition to this last extract we append the following, taken from the same work, which directly contradicts it:

"It is a law which holds good in *all* elastic fluids, that they occupy spaces which are inversely as the pressures to which they are subjected, and their densities are in consequence in the *direct ratio* of the pressures."—*Renwick on the Steam-Engine, p.* 14, *new edition.*

But in order if possible to confuse the student or engineer still more, there is given in almost all of the works from which the extracts are taken, tables, showing the number of volumes of steam for a given pressure compared to the volume of water that produced it, and consequently showing that the density *does not* increase in the same ratio as the pressure.

By the term density, used in the foregoing extracts, is understood the specific gravity of steam, and it will be seen by examining them that the fourth extract directly contradicts all the others; yet, notwithstanding this large majority against it, we have no hesitation in saying that it is correct.

We shall now endeavor to show *why* the non-condensing engine, working at some given pressure, *is* equal in point of economy of fuel to the low-pressure condensing engine. This we conceive to be attributable to two distinct parts of the operation:—

1. The greater economy of fuel in the generation of steam of a high pressure compared with that of a lower one.

2. The economy arising from the superior effect produced by the steam, when used at a high-pressure, to that when used at a lower one.

In order to show that the above mentioned causes are those to which the asserted economy in the use of high-pressure steam is due, it will be necessary to introduce the following table, showing some of the properties of steam: the three first columns of which are extracted from a similar one published in Pambour's Theory of the Steam-Engine; the fourth column is calculated from the comparative volumes of steam to the volume of water that produced it; and the fifth is calculated from the fourth. Similar tables containing the first three columns can be found in almost every scientific treatise upon the steam-engine: this is selected merely from the fact of its being more complete than most of them.

In this table we have made a total pressure of 15 lbs. per square inch our starting point, and throughout this article we shall consider it equal to the pressure of the atmosphere, although strictly speaking it is a fraction greater; but it is sufficiently correct for our purpose.

By examining the following table, it will be seen that whenever the pressure is doubled, the density, as given in the fourth column, falls greatly short of it. For instance: at 15 lbs. pressure the density is represented by 100; and at 30 lbs. or double the pressure, the density is but 189.

Total Pressure in lbs. per sq. inch.	Corresponding Temperature by Fahrenheit's Thermometer.	Volume of steam compared to the volume of water that produced it.	Rel. dens. of the steam—that at15 lbs. or the press. of the atmosph. being called 100.	Pressure of the steam if only in a direct ratio of the densities—in lbs.
15	213.0	1669	100	15.
20	228.3	1280	130	19.5
25	240.7	1042	160	24.
30	251.2	882	189	28.3
35	260.3	765	218	32.7
40	268.4	677	246	36.9
45	275.7	608	274	41.1
50	282.3	552	302	45.3
55	288.4	506	330	49.5
60	294.1	467	357	53.5
65	299.1	434	384	57.6
70	304.2	406	411	61.6
75	308.9	381	438	65.7
80	313.5	359	465	69.7
85	317.8	340	491	73.6
90	321.9	323	516	77.4
95	325.8	307	544	81.6
100	329.6	293	569	85.3

Again: at 40 lbs. pressure the density is 246; but at 80 lbs. or double the pressure, it is but 465.

And again: at 50 lbs. pressure the density is 302; but at 100 lbs. or double the pressure, it is but 569.

By referring to the fifth column, which represents the pressures that the steam should be equal to, provided the law given in the majority of the extracts quoted in the first part of this paper was correct, viz: "that the density is directly proportional to the pressure," we find a great discrepancy between these and the actual pressures. For instance: at a temperature of 251.2 degrees, the pressure is stated in the first column at 30 lbs.; but by running the eye across to the fifth column, we find, if this law be correct, that the pressure should be only 28.3 lbs.

Again: at a temperature of 329.6 degrees, the pressure, as given in the first column, is 100 lbs.; but by examining the fifth column it appears that the pressure, to be strictly proportional to the density, should be only 85.3 lbs. The numbers in this column also show the relative amounts of fuel required to maintain the steam at the pressures given in the first column.

Now let us examine whether or not the numbers given in the fourth and fifth columns are correct; and in order to do this it will be necessary to institute a comparison between the first and third columns. In so doing, it will be found that the volumes of steam (as compared with the volume of water which produced them) are not precisely in an inverse ratio to the pressure; but that when the pressure is doubled, the volumes of steam are greater than one half of the number at the former pressure. As an instance, take 15 lbs. pressure in the first column, the corresponding volumes of steam in the third column are 1669; now at double the pressure, or 30 lbs. the volumes of steam are 882, being about 47 volumes greater than one half the number of volumes at 15 lbs. pressure. As another instance take 50 lbs. pressure: the corresponding volumes of steam are 552; but at double the pressure, or 100 lbs. the volumes are 293, or 17 volumes greater than one half.

The volumes of steam proportional to the water which produced them, and also the temperature of steam at different pressures, as given in the foregoing table, have been proved correct by numerous experiments, and implicit reliance may be placed upon their accuracy. Now as the fourth and fifth columns are calculated from the column of the volumes of steam, we think the whole table may be considered correct.

It is necessary to be thus particular in showing the accuracy of the foregoing table, as the whole of the following chain of reasoning, which is to show the cause of the asserted economy of high-pressure engines, is dependent thereon for its value; therefore if the table be inaccurate the whole must be fallacious.

It has been satisfactorily ascertained, by numerous well-conducted and accurate experiments, that any given amount of fuel will convert a certain quantity of water into steam, without regard to the pressure under which it is evaporated; or in

other words, the same amount of fuel that will evaporate a cubic foot of water, under a pressure of steam equal to one atmosphere, would evaporate the same quantity, were the pressure of steam equal to five or ten atmospheres.

It follows from this, that the amount of fuel required to generate steam of different pressures is in the direct ratio of their densities; therefore if we represent the quantity or weight of fuel required to generate a cubic foot of steam of a total pressure of 15 lbs. or one atmosphere, by 100, the fourth column of the table, or the column of relative densities, will show the relative amount of fuel required to generate a cubic foot of steam of any other pressure given in it.

We shall see by reference to the table, that allowing 100 parts of fuel to be required to generate a cubic foot of steam of 15 lbs. pressure, but 189 instead of 200 parts are required to generate the same bulk of steam of 30 lbs. pressure; and but 357 instead of 400 parts are required to generate the same bulk of 60 lbs. pressure.

It follows, therefore, that the pressure and mechanical efficiency of steam increase in a greater ratio than the consumption of fuel; consequently we may arrive at so great a pressure in the use of steam in non-condensing engines, as that the advantage gained in this manner shall equal in effect that acquired by condensing the steam in a low-pressure engine.

We conceive that we have thus established the truth of the first reason assigned by us for the economy of high-pressure non-condensing engines, viz. "the greater economy of fuel in the generation of steam of a high-pressure compared with that of a lower one."

After having examined the foregoing table, and followed out the chain of reasoning here presented, the question naturally arises, *Why* the pressure of steam increases in a greater ratio than the density?

We will now endeavor to explain as clearly as possible what we apprehend to be the cause.

Suppose a boiler to be charged with water and steam, in a similar manner to a boiler in ordinary use at a pressure of 15 lbs. and consequently at a temperature of 213 degrees, and the

pressure is increased to 40 lbs.; the temperature is consequently raised to 268.4 degrees, or an addition of 55.4 degrees. By reference to the fifth column of the table, it will appear that had the pressure increased only in the same ratio as the density, it would be but 36.9 lbs. instead of 40 lbs.; the difference, or 3.1 lbs. remains to be accounted for.

It is a known law that gases expand about $\frac{1}{480}$ part for every degree of increase in their temperature; and if confined, instead of expanding $\frac{1}{480}$ part, the pressure in the vessel by which it is contained will be increased $\frac{1}{480}$ part.

Now returning to the foregoing supposition: the 55.4 degrees of heat added to increase the pressure to 40 lbs. acts in two ways: First, by an increase in the density of the steam by the evaporation of more water. Secondly, by increasing the temperature of the steam.

According to this law of the expansion of gases by heat, increasing the temperature of the steam must increase the pressure that is already produced by the increase of its density $\frac{1}{480}$ part for every degree that the temperature is increased. Let us now see what will be the result of this mode of reasoning at three different pressures—say at 40 lbs. 60 lbs. and 100 lbs.

As stated before, the pressure at a temperature of 268.4 degrees is 40 lbs; but if the pressure were only in proportion to its density it would be but 36.9 lbs.; and to increase the pressure from 15 lbs. to 40 lbs. there has been an addition to the temperature of 55.4 degrees; therefore, $\frac{36.9\times55.4}{480}=4.26$ lbs. increase in the pressure; and $36.9+4.26=41.16$ lbs. instead of 40 lbs. or a difference of 1.16 lbs.

At the temperature producing a total pressure of 60 lbs. the pressure would be only 53.5 lbs. if it were in proportion to the density, and the addition to the temperature above that of 15 lbs. or the pressure of the atmosphere is $294.1-213=81.1$ degrees; therefore, $\frac{53.5\times81.1}{480}=9.04$ lbs. increase of pressure; and $53.5+9.04=62.54$ lbs. pressure, instead of 60 lbs. the real pressure, or a difference of 2.54 lbs.

At the temperature producing a total pressure of 100 lbs. were

the pressure in proportion to the density, it would be but 85.3 lbs. and the addition to the temperature above that of 15 lbs. is 329.6−213=116.6; thence, $\frac{85.3\times116.6}{480}$ =20.7 lbs. increase of pressure; and 85.3+20.7=106 lbs. or a difference of 6 lbs.

We are of opinion that the discrepancies existing between these results and the actual pressures may be fairly attributed to an incorrectness in the elements of, and not to the principles embodied in the calculations, as a very slight difference between the given temperature, or volumes for any pressure, and the actual temperature or volumes, would be sufficient to correct those discrepancies; or the fraction given as the expansion of gases for each degree the temperature is increased, viz. $\frac{1}{480}$ part, may not be the *exact* expansion; and where the temperature is increased so many degrees, as in the foregoing cases, it would sensibly affect the result.

We conceive, however, that these results approximate sufficiently near the actual pressures to show the principles to be correct upon which the calculations are founded.

We come now to the second reason assigned for the economy of high-pressure engines, viz. "the superior economy in the consumption of steam by the engine when used at a high-pressure instead of a lower one."

This arises from the fact that the total amount of losses from the pressure of the atmosphere, friction, and other causes, does not increase in the same ratio as the effective pressure of the steam acting upon the piston, but is nearly a constant quantity; consequently, the greater the pressure of the steam upon the piston, the smaller will be the ratio between the sum of the losses and the whole force exerted.

In order to show this clearly, we will compare the results produced by a non-condensing engine, working under two different pressures, say with pressures above the atmosphere of 20 lbs. and of 80 lbs. or total pressures of 35 lbs. and of 96 lbs. per sq. inch upon the piston, and thus exhibit the ratio between the losses and the whole force exerted by the different pressures. But to be able to accomplish this, we must first determine the amount of the losses in each case.

The items of loss, when working under a pressure of 20 lbs. per square inch above the atmosphere, we will suppose to be—

Press of atmosphere, per sq. inch	15.00 lbs.
Power required for working valves	0.50 "
" " " pumps	0.50 "
Friction of piston	1.00 "
Friction of journals and other working parts	3.50 "
Total amount of losses	20.50 lbs.

Now, 20 lbs.+15 pressure of atmosphere=35 lbs.; and 35.00—20.50 lbs.=14.50 lbs. pressure, the whole effective force exerted per square inch upon the piston by the engine, and being 41.4 per cent of the whole power upon the piston.

The total amount of losses, when working under a pressure of 80 lbs. per square inch above the atmosphere, is but little greater than when the pressure is but 20 lbs. above the atmosphere; for it is evident that the principal item of loss, which is the pressure of the atmosphere, is the same in both cases; and the increase of friction of the piston, journals, &c. is but trifling. The items of loss will then be—

Pressure of atmosphere per sq. inch	15.00 lbs.
Power required for working valves	2.00 "
" " " pumps	2.00 "
Friction of piston	1.50 "
Friction of journals and other working parts	4.50 "
Total amount of losses	25.00 lbs.

Thence, 80 lbs.+15 lbs. pressure of atmosphere=95.00 lbs.; and 95.00—25.00=70.00 lbs. pressure per square inch, the whole force exerted upon the piston, by which a useful effect is produced, being 73.7 per cent nearly of the whole force upon the piston.

Thus theoretically there is 32.3 per cent more power usefully applied when working at the higher than at the lower pressure, but practically the difference is not so great as here represented, as there is almost necessarily a greater loss from leakages, and and greater radiation of heat from pipes, cylinder, &c. when working at the former than at the latter pressure.

Having thus, as we think, satisfactorily shown not only that it is more economical to generate steam of a high pressure than a lower one, and also to use it at a high pressure in working non-condensing engines, but that there is some given pressure at which, if used in non-condensing engines, it will render them equally economical with the ordinary condensing engine used in the English practice; we will endeavor to ascertain what that pressure should be, supposing the steam to be worked at its full pressure during the whole length of the stroke of the engine. For the condensing engine we will assume as the working pressure 5 lbs. per square inch above the atmosphere, or a total pressure of 20 lbs. per square inch. The items of loss in this engine will be—

Imperfect vacuum, per sq. inch	2.25 lbs.
Power required for working valves.....	0.50 "
" " " air-pump.....	0.75 "
Friction of piston	0.40 "
Friction of journals and other working parts	2.25 "
Total am't resistances in condensing engine	6.15 lbs.

By reference to the fourth column of the table given in the first part of this article, it will be observed that by assuming the fuel required to maintain the steam at the pressure of the atmosphere at 100 parts, the amount required to maintain the steam at 20 lbs. will be 130 parts.

Now the total pressure upon the piston is 20 lbs. and the total amount of resistances is 6.15 lbs.; thence, 20 lbs.—6.15 lbs.= 13.85 lbs. pressure per square inch as the available power: this is obtained at an expense of 130 parts of fuel: thence $\frac{130}{13.85}=9.38$ parts of fuel to obtain 1 lb. pressure per square inch available power upon the piston.

Our object now is to find at what pressure per square inch it is necessary to maintain the steam for a non-condensing engine, so that each 9.38 parts of fuel will produce 1 lb. pressure per sq. inch upon the piston available power. This will be found to be 60 lbs. total pressure, or 45 lbs. pressure above the

atmosphere, as the following calculation will show. The items of loss may be estimated thus :—

Pressure of atmosphere per sq. incn	15.00 lbs.
Power required for working valves	0.90 "
" " " pumps	0.90 "
Friction of piston	1.20 "
Friction of journals and other working parts	4.00 "
Total amount of resistances	22.00 lbs.

The whole pressure upon the piston is 60 lbs. per square inch, and the whole amount of resistances is 22 lbs. per square inch; thence, 60 lbs.—22 lbs.=38 lbs. pressure per sq. inch available power, which is obtained, as will be seen by reference to the 4th column of the table, by an expenditure of 357 parts of fuel; then $\frac{357}{38}$ =9.39 parts of fuel for each lb. available pressure per square inch upon the piston.

It would thus appear, that by working a non-condensing engine with steam of a pressure equal to 45 lbs. per square inch above the pressure of the atmosphere, the expenditure of fuel in proportion to the available power is nearly the same as in working a condensing engine with a pressure of steam equal to 5 lbs. per square inch above the pressure of the atmosphere.

But this pressure is only *theoretically* equal in economy of fuel to the condensing engine; practically, a pressure would be required somewhat greater, from the loss by leakages, radiation of heat, &c. being greater in the non-condensing than in the condensing engine.

We believe that every engineer who has had experience in working both classes of engines, is fully satisfied of the truth of the proposition set forth in the commencement of this paper, viz. " that a non-condensing engine may be worked with steam of some given pressure per sq. inch that shall equal in economy the ordinary condensing engine used in the English practice."

Our object has been to give some satisfactory explanation why this is the case; and in attempting to do this we will not pretend that the items of resistance given for each description of engine are precisely correct, as we have stated them accord-

ing to our judgment, having no experiments to refer to from which to arrive at their precise amount; neither do we pretend that the calculations are made with mathematical accuracy, as our purpose did not require it; but if any of the principles and reasonings here advanced, upon which these calculations are based, are incorrect, or founded upon incorrect premises, we should be as much gratified to see them disproved as any one; our only object being to arrive at a correct exposition of the facts. C.

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ON THE EFFECTS OF ARTS, TRADES, AND PROFESSIONS, AS WELL AS HABITS OF LIVING, ON HEALTH AND LONGEVITY.

No. V.

As the possession of health is essential to happiness and usefulness and to all profitable labor, and as the wealth of the world is but the product of individual labor, there perhaps can not be a more important subject for consideration than the effects of exercise or labor on the physical constitution of man. This survey indeed is necessary in order to a full understanding of the next division of our subject, viz. *the influence of undue exertion, or inordinate exercise of the physical powers.*

There are three great classes of natural laws with which every rational being ought to be made acquainted, as obedience to them, which necessarily implies such knowledge, is essential to his physical, intellectual and moral well-being.

Law has been defined by Blackstone to be a *rule of action;* and is applied indiscriminately to all kinds of action, animate or inanimate, rational or irrational. Certain principles, for example, have been impressed upon matter, such as gravitation, from which it cannot escape, and without which it would cease to be. So also, when matter is put into motion, there are certain laws of motion to which all moving bodies must conform.

Inanimate and animate matter, or substances and beings,

sustain certain fixed relations to each other, and modify each other's action, in an established and definite manner, according to that relationship. "Every natural object," says Mr. Combe, "has received a definite constitution, in virtue of which it acts in a particular way: there must therefore be as many natural laws as there are distinct modes of action of substances and beings, viewed by themselves." These relations or "laws," however, are all comprehended under the three classes above mentioned.

The *physical* laws embrace the phenomena of mere matter, such as those pointed out in works on chemistry and natural philosophy.

The *organic* laws are the established modes according to which all phenomena connected with the production, health, growth, decay and death of vegetables and animals take place.

The *moral* and *intellectual* laws relate to all the manifestations of mind, including the rational faculties and the moral powers.

The most important characteristics of these laws, according to Mr. Combe, are: 1st, that they are independent of one another; 2dly, that they are universal, unbending, and invariable in their operation.

The independence of the natural laws may be thus illustrated: An individual may be highly moral, and like a Howard, devote his whole time to works of benevolence; yet if he, like this philanthropist, expose himself to contagion amid the foul air of prisons, and be subjected to loss of sleep, great anxiety and fatigue, while at the same time his food is innutritious and indigestible, he will probably pay the penalty in disease, and be very fortunate if he escape with life. On the other hand, a person may habitually disregard the rights of his fellow man, and violate many of the moral laws, and still, by obeying the others, preserve his health, and perhaps attain old age.

Again: as the natural laws are coëxtensive with the limits of the globe, and the same in every age, every living being comes under their control, and by no art or skill can he escape their influence. If, then, the loss of health be in every instance the result of the infringement of one or more of these laws or conditions essential to the well-being and activity of every organ

the knowledge and observance of which are to a great extent within our own power, there can be no excuse for those who wrap themselves up in their ignorance, and perhaps apologize for their indifference, by saying either that disease is the result of the direct agency of God, and inflicted by him for the purposes of moral training and correction; or, that it is the result of circumstances inherent in and inseparable from the present condition of man. So far did the belief that the enjoyment of health was in our own power, prevail among the ancients, that Asclepiades, a celebrated physician in Rome, publicly declared that he was content to pass for an idiot, if ever attacked by illness, or if his death was caused by any thing but old age or accident. That he was sufficiently correct in what he understood the natural laws to be, appears from the fact that he lived more than a century without any illness, and died at last from the effects of a fall.

It is remarkable that with the well-known facts now before the public, in relation to the effects of systematic exercise by pursuing a regular course of *training*, any one can doubt that the physical powers of man may be vastly increased, and that it actually is optional with us whether we will have sound and healthy or weak and infirm bodies. Captain Barclay, in his "System of Training," mentions instances where in the course of a few weeks persons, who had previously been unable to walk a few miles, have been enabled to walk as many as 30 in a day. Not only the muscles, but every part of the human frame, is in this manner invigorated; and as long life depends in general on the possession of strong and healthy organs, it follows that man has it in his power to prolong his life.

We have already pointed out some of the laws connected with respiration, and shown how they are frequently violated, as well as the consequences of such violation. We come now to those connected with *muscular exercise;* but as our limits are necessarily brief, we must pass over many points of interest on which we might perhaps profitably dwell.

Exercise seems to have been ordained by Providence as the grand safeguard of the animal machine, and it bears the same relation to the health of the body as the agitation of the atmo-

sphere and the ocean does to the purity of those elements. Inaction in the one case, and stagnation in the other, would speedily breed corruption and death. Motion, indeed, is the life of the world: all nature seems to exult in motion. It is seen in the revolutions of the planetary spheres, and is no less visible in every form of animal and vegetable life. The *sap* of the latter performs its circuit with no less regularity than the *blood* of the former. The young, especially, of every variety of animated being, from the *ephemera* just warmed into existence by the solar beam in which it sports, to the infant whose limbs are never at rest, all seem to delight in the exercise of this faculty.

The organs which constitute what is called the motory apparatus, are the bones, muscles, nerves, spinal marrow and brain; the bones, with the cords or tendons, and ligaments, forming what may be considered as the *passive* organs of locomotion; while the muscles and nerves are the *active* ones. The muscles or *flesh* of animals are composed of an elementary fibrous tissue, which possesses the power of contractility, in obedience to the command of the will; and in order to this, every fibre is supplied with a distinct nerve and blood-vessel. The smallest fibre visible to the naked eye is found, under the microscope, to be made up of an immense number of ultimate filaments, lying parallel to each other, and of the same shade in all animals, though differing in size. These fibres are gathered into little bundles, thousands of which compose the mass of every muscle, while each fibre, fasciculus and muscle is invested with a sheath of cellular membrane or tissue, which facilitates their motion on each other. It is the union of all these sheaths of cellular tissue which form the cord or tendon at the extremity of the muscle; so that there is not only a close relation between the tendon and muscle generally, but between every fibre of the muscle and the tendon.

Voluntary motion implies a contraction of the muscles under the influence of the will. This is sent along the nerves, whose agency is necessary in effecting the required movement, and of course passes through the chain of the spinal marrow, from which nerves are given off to all parts of the body. If the

nerve be divided which supplies any muscle, the power of that muscle is gone; or if the brain be injured by any cause, which interrupts its functions, whether it be a blow, or the influence of a narcotic, voluntary motion is at an end.*

In order to muscular contraction, it is not only necessary then that muscles should be properly organized, but that they should be endowed with a vital property called *irritability*. If we cut off a supply of arterial blood to a muscle, by tying the vessel which goes to it, we find it no longer contracting, although its connection with the brain by means of nerves be uninterrupted. After a muscle has contracted for some time, it becomes fatigued, and a painful sensation is the consequence: the weaker the system, the sooner is this sensation experienced. Contraction and repose, frequently alternated, are most agreeable, and most in accordance with the constitution of nature. The relaxation of a muscle is merely a passive state, and indicates a suppression of volition, or a supply of nervous power. We see this beautifully exemplified in locomotion. First the flexors act; then the extensors: the muscles of the pelvis, thigh, leg, and foot, being alternately brought into action, to the relief of each other, and so as to expedite progression to the greatest advantage. A continued act of volition would soon exhaust the brain, as continued contraction would the muscle.† The *force*

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*Muscles exist in animals of all classes, from the *mammifera* to the *radiariæ*: they have been discovered in a great number of *entozoa*. Even in the *actiniæ*, some *medusæ*, and other *zoöphyta*, muscular fasciculi, interwoven with the external skin. have been perceived; and Ehrenberg has discovered them in the *infusoriæ*. Their fibres are not always red, but may be white or yellowish. The strength of the muscles of some of the insects is prodigious. A common beetle weighing but 15 grains, has been known to heave up the earth under a weight equal to 4796 grains—319 times its own weight, and also to remove the same pressure when placed on one of its legs. If man was as strong in proportion, a person weighing 200 lbs. ought to lift about 31 tons. A flea, says Dr. Elliotson, can draw from 70 to 80 times its own weight, which is less than one grain, and will leap 200 times its own length. Supposing a man weighing 150 lbs. could leap in proportion, he would be able to spring more than 50 miles—or, in proportion to his length, 1200 feet.

†Dr. Wollaston and others suppose that muscular contraction is attended with a vibratory sound, and that such contractions are going on continually. In proof of this, he adduces the experiment of inserting the finger or thumb in the ear, when a distinct rumbling noise is heard; whereas no sound is produced when any similar shaped body of wood or other matter is employed. This noise, however, may be

of muscular contraction depends, then, upon the nervous energy as well as the physical condition of the muscle. *Size*, other things being equal, is the measure of the power of the muscle, as it is of the brain and other organs. When a person is laboring under strong cerebral excitement, the efforts of strength put forth are often astonishing. "In such cases," says Dunglison, "the delicate muscles of the female are capable of contracting with a force far transcending that of the healthy male: the power of muscular contraction is therefore in a compound ratio with the strength of the organization of a muscle and the degree of excitation of the brain. Where both are considerable, the feats of strength surpass belief; and where both are small, the results are insignificant."

The force of muscular contraction varies not only in individuals, but among the different races of mankind. The aborigines of our own continent are inferior in strength to the Anglo-Saxon and other European races. The Asiatics, particularly the Hindoos, are weaker, as a general rule, than the nations of Europe. Peron, in his voyage round the world, employed one of Regnier's dynamometers, which determines the relative force of men and animals. Directing his attention chiefly to the strength of the arms and of the loins, he made trials on several individuals of various nations, viz. 12 natives of Van Dieman's Land, 17 of New Holland, 56 of the island of Timor, 17 Frenchmen belonging to the expedition, and 14 Englishmen in the colony of New South Wales. The following were the results:

	Strength of the Arms. Killogrammes.*	Strength of the Loins. Myriagrammes.
Van Dieman's Land	50.6	—.—
New Holland	50.8	10.2
Timor	58.7	11.6
French	69.2	15.2
English	71.4	16.3

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produced by the circulation of the fluids, though there are some facts which lend much plausibility to Dr. W.'s theory. If the biceps muscle be pressed against the ear, e. g., and the fore-arm bent, a similar sound is heard; and so of other muscles.

* The value of a killogramme is about 2 lbs. avoirdupois, and that of a myriagramme about 20 lbs.

The highest numbers in the first and second divisions were respectively 60 and 62; the lowest in the fifth 63, and the highest 83, for the strength of the arms. In the power of the loins, the highest among the New Hollanders was 13, and the lowest of the English 12.7.*

The mean effect of the labor of an active man working to the greatest possible advantage, has been estimated to be sufficient to raise ten feet in a second for ten hours in a day, or to raise 100 lbs. 1 foot in a second, or 36,000 feet in a day, or 3,600,000 lbs. or 432,000 gallons, one foot in a day. According to Dr. Desaguliers, the weakest men, who are in health and not too fat, lift about 125 lbs.; and the strongest of ordinary men 400 lbs. Individuals have been known to lift 800 lbs. The daily work of a horse is estimated to be equal to that of five or six men.

Such are some of the most important laws and facts connected with muscular contraction. We are now prepared to consider briefly the effects of exercise, when confined within normal limits. These may be regarded as *local* or *general*. The local effects of exercise are obvious, in the enlargement and condensation of the muscles themselves, and their increased elasticity, strength and firmness. In proof of this, we may refer to the enormous development and corresponding strength of the muscles of the leg in rope-dancers and circus-riders; and of the arm in prize-fighters, fencers, smiths and carpenters; and of the shoulder and back in rowers and sailors, occasioning an arched protuberance or contour, more indicative perhaps of strength than beauty. Indeed, if a man has spent much time in some mechanical occupation which requires the action of particular muscles, these are easily distinguished through their disproportionate magnitude. Thus, if there be a permanent obstruction

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* Dr. Edwards, of Paris, has shown that muscular strength varies at different periods of the day, and is much affected by diet. By means of the dynamometer, he found it to increase during the first half of the day, and decrease during the latter, and that it was constantly increased by a moderate and nutritious meal, except in the weak, in whom the immediate effect of a meal was depression of strength. This is explained by the well-known fact that the muscles are then deprived of that degree of nervous energy necessary to strong contraction, it being concentrated upon the digestive organs.

to the circulation of the blood, the heart, from the increased labor to which it is subjected, becomes thickened and enlarged. The effect of exercise upon the muscles is seen, by comparing the flesh of wild game with that of the same species domesticated: the one is of a deep red color, firm, and of a compact texture; the other is paler, and comparatively flabby and soft. This is owing to the circumstance that more arterial blood is sent to those muscles which are most employed, and that the fibrine is more highly animalized and more perfectly organized. As every organ in the body has a distinct function, the proper performance of which is not only essential to the general health of the body but to its own well being, so exercise is essential to the preservation of its integrity; and in proportion as it is deprived of exercise, in the same proportion will be its debility and its liability to derangement and disease.

One of the most striking general effects of exercise is, to increase the circulation of the blood by exciting the action of the heart. The arteries, for the most part, lie deeply imbedded among the muscles; by the contraction of which they are compressed, and the blood in this manner propelled towards the extremities and among the minute capillaries; and by the same mechanical pressure upon the veins it is aided in its return to the heart, which in its turn is stimulated by the rapid flow of blood into its cavities to increased efforts to expel it: the consequence is, that it performs its circuit in a much shorter time than when the body is in a state of inaction and repose. This effect of muscular contraction is seen in bleeding, when the patient is directed to grasp something in his hand, the blood is rapidly propelled towards the heart, but as its progress is interrupted by the ligature, it flows in an accelerated current from the orifice in the vein. As exercise thus quickens the circulation, more blood is of course sent to each organ, as the lungs, the liver, skin, kidneys, brain, &c. and in consequence the functions of those organs are more perfectly performed, while the organs themselves are strengthened. The blood, from its more rapid circulation through the lungs, is more thoroughly decarbonized and oxygenated, and thus better fitted for the more perfect growth and nourishment of the entire body. The

elimination of effete and deleterious matters from the blood is thus facilitated in a very important degree, and from the influence of highly purified blood upon the brain, the mental operations become clearer, more rapid, and energetic. The student well knows how much more satisfactorily he can pursue a train of investigation after the exhilarating exercise of a morning's walk; and the reason is doubtless to be found in the explanation above given.

Consequent upon the increase of the circulation of the blood from exercise is the increase of *secretion*, *nutrition*, *absorption*, *calorification*, &c. We have stated that the capillary circulation is much augmented by exercise: we should therefore expect that those functions which are referred to the minute arteries would also be augmented; and such we find to be the fact. It is in this way we explain the development of those muscles which are habitually exercised; and in the same manner we account for increased exhalation and absorption. Where muscles are much employed, we find the fat absorbed not only between them, but from their external surface, rendering their outlines distinct and well marked; whereas, if they remain inactive, as in females, they become covered with a layer of fat, while the fibres shrink, and become pale and flabby.

Exhalation and absorption are generally nearly equally balanced in a healthy subject who takes suitable exercise: if there be an increase of weight, it will be muscular, or solid flesh. But in persons of indolent habits, where nutrition preponderates over absorption, the augmentation will consist of fat alone, which may be considered an evidence of disease, and not of health. We see however that in some cases, persons employed in active labor lose instead of acquiring bulk; but here the exercise is pushed too far, and perhaps an insufficient supply of food is taken. The plan adopted by jockeys to reduce the weight is, to allow a scanty supply of nutriment, prescribe severe exercise, and frequent profuse sweats; and Capt. Barclay recommends the same method.* In very warm climates, or among those

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*The object sought to be attained by *training* is, "to improve the wind," and strengthen the muscles; and in doing this, every part of the body is invigorated. There can be no doubt that training might be advantageously employed to a far

employed in forges, furnaces, and smitheries, great bulk is rarely if ever attained, as secretion in the form of perspiration is so active and copious.

Another prominent effect of exercise is to strengthen the *digestive* function. As the expenditure of fluids is increased by the free secretions, there is an urgent demand created to supply the deficiency. The consequence is, that the desire for food recurs with more regularity and strength, and chymefaction, chylification, and the other processes of the digestive function, are performed with greater promptness and energy. The gastric, pancreatic and biliary fluids, or solvents, are poured forth in enlarged quantities, and the whole system speedily feels the inspiring influence of renovation and health.

The function of *respiration*, so closely connected with the circulation, participates with it in the exhilarating effects of exercise; and though the blood may be sent more rapidly into the lungs for purification, yet the respiratory movements will keep pace, and furnish ample facilities for the required sanguineous changes.

We might also dwell, did our limits permit, upon the effects of exercise upon the sensations and intellectual faculties, and show how the former are rendered more acute, and the latter invigorated by its influence. We are not of those who believe that a high range of health is incompatible with the most vigorous exertion of the mind, and that this requires, as we acknowledge it too often induces, a standard of health somewhat below par. The imagination, doubtless, may be exalted by a feeble physical organization, as was witnessed in Horace, Voltaire, and Pope; but we deny that mental symmetry can exist in a state of bodily imbecility and suffering, or that the intellect can shine forth in its just and harmonious proportions, and with

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greater extent than it is for the cure as well as prevention of disease. Heraclitus first applied the exercises and regimen of the gymnasium to the removal of disease and the maintenance of health; and Asclepiades is said by Celsus to have carried this so far as almost to have banished internal remedies from his practice. If exercise and regimen are the most important preservatives of health, it is to be presumed that in chronic diseases they will prove the most efficient remedies. Donald Walker recommends exercise as the best remedy for bilious complaints, obesity, rheumatism, gout, &c.

equal strength and beauty. It is to be observed, however, that when exercise is carried so far as to induce a sense of fatigue and exhaustion, the brain participates in that condition, and mental efforts become wearisome and painful. There is a great difference, it is true, in the power of endurance in different individuals—some being capable of performing with ease an amount of bodily and mental labor which would entirely exhaust half a dozen ordinary men. Such are Lord Brougham, Daniel Webster, Henry Clay, and others who could be named—men who have left the impress of their minds upon the age that gave them birth, and engraved their names in imperishable lines upon the pedestal of their country's fame and glory. And who will deny that even these men owe something of their greatness to physical organization and temperament? In a word, exercise may be said to stimulate the circulation of the blood—create an agreeable warmth—enliven and invigorate the mind—promote digestion, respiration and nutrition—and accelerate all the bodily functions.

Such are some of the most important effects of exercise, when confined within moderate or normal limits. When carried beyond this, the evils which it occasions are of hardly less magnitude than the benefits already pointed out. Over exertion of the body lays the foundation for sickness and early dissolution, in many occupations, by exhausting the excitability of the frame, and producing an irregular action of the capillaries, leading to organic mischief; as in miners, pavers, canal and well-diggers, coal-heavers, hod-carriers, smiths, and ditchers. When violent exertions are made, serious lesions are apt to occur in different organs and structures: such as aneurism of the large vessels, dilatation of the heart, sprains, dislocations, lacerations of the muscles, hemorrhages from the nose and lungs, &c. *Hernia* is very common among nearly all the laboring classes; particularly porters, draymen, masons, hod-carriers, and others who are in the habit of lifting great weights. So prevalent is this accident in London, that a truss society has existed in that city for many years, for the gratuitous supply of trusses to those who may be afflicted with this evil, and unable, from the scanty proceeds of their labor, to purchase an

instrument. In the year 1838, Mr. Marshall, Deputy Inspector General of Army Hospitals, published a table, containing the numbers rejected as conscripts or recruits on account of hernia, in Dublin, Edinburgh, Glasgow, and France. From this it appears, that of 42,740 recruits examined at Dublin, out of 10,279 rejected, 920 were on account of hernia, being 21.5 per 1000 recruits, or 1 in 11 of the number rejected. Of 9528 examined at Glasgow and Edinburgh, 2375 were rejected, of whom 65 were for hernia, being 7.1 per 1000 recruits, or 1 in 36 of the number rejected. In France, out of 126,669 examined, 46,669 were rejected, of whom 3948 were on account of hernia, being 31.2 per 1000 recruits, or 1 in 11.8 of the number rejected. Thus it appears that the ratio of rejections for hernia in Dublin is three times as great as that of Glasgow and Edinburgh. Hernia appears to be 50 per cent higher among conscripts in France than among recruits examined in Dublin. There are no sufficient data by which to estimate the proportion of cases of hernia among the population of this country, though there can be no doubt that it is as large as in France or Ireland.

[For the American Repertory.]

ON THE LATENT HEAT OF STEAM.

The remarkable changes produced by the introduction of steam as a mechanical agent; the benefits which it has conferred on civilized life; and, above all, the vast prospective advantages of a proper application of this mighty power, render it a duty in those who conduct a scientific journal to guard against the dissemination of erroneous theories on the *latent heat of steam.*

Most of the readers of your highly useful and instructive journal must therefore have felt some surprise on perusing the article "On the Steam-Engine," which appeared in your number for August. With every disposition to refute, at the time, the fanciful doctrine therein promulgated, I have delayed doing so, in hopes that the task might fall into abler hands; but being disappointed in this expectation, I will now, with your permission, endeavor to correct the errors which I will prove are con-

tained in the article under consideration; but in doing this, I can assure the author of the views which now will form the subject of my animadversion, that my motive is simply that of preventing a misconception of the true nature of steam, in the minds of those who have not had an opportunity of obtaining correct knowledge of the theory of this important mechanical agent, and who are, in my opinion, most likely to benefit or suffer by the information received.

Before entering on the subject, I cannot refrain from noticing that your correspondent recommends the expansive mode of using steam, in language for which there is not the least occasion; indeed, the only inference to be drawn from his tone is that the economy of expansive steam is neither understood nor acknowledged in this country. Now this is a palpable injustice to the American engineers; there being not one single steamboat in the whole Union in which steam is otherwise worked than on that principle: in this section of the country, in particular, the engineers, proverbial for practical knowledge, have greatly excelled the marine engineers on the other side of the Atlantic, and carried this obvious mode of using steam almost to the highest state of perfection of which the principle is susceptible.

The extravagant notion of Prof. Renwick, or the ignorance of Mr. Palmer, as to the maximum power of steam, surely furnishes no reason to treat the subject in a manner calculated to detract greatly from the praise due to those who by the great practical results which they have achieved, have proved how well they understand it, and how fully they appreciate the value of a principle which has been thus ostentatiously propounded, and most erroneously assumed to be, not only unknown but resisted.

The article in question derives additional importance from the plausible inferences contained therein, that had some of our most eminent though unsuccessful experimentalists been favored with the light which the writer imagines that he has thrown on the subject, by demolishing to *his* entire satisfaction our old-fashioned ideas about latent heat, much time and money would have been saved. I will endeavor to prove that the tendency

of his reasoning will infallibly be to increase the evil complained of; and that had the unsuccessful parties alluded to known as much about the latent heat of steam as some philosophers who lived nearly a century before that time, they would in all probability have escaped the losses and disappointment attending their futile efforts.

Your correspondent, in pointing out the danger of admitting the established theory of latent heat, generously finds an excuse for Evans, Perkins, and Wolfe, on account of the "*seeming vastly increased effect of heat on the thermometer.*" The vastly *increased* effect of heat! Had he said the vastly *diminished* effect of heat indicated by the *thermometer*, and the vastly *increased* elastic force of the steam as indicated by the pressure guage, he could hardly have failed to discover that it was the want of knowledge as to the immense quantity of *latent heat*, of which the thermometer *gave no indication*, which induced our less theoretical experimentalists to waste their time and funds in the pursuit of a phantom which will inevitably be presented to the imagination of every uncultivated projector who may chance to have the misfortune of believing what is now so strenuously urged, viz. "that heat in steam never becomes latent." As a matter of course, "since steam contains no latent heat, the indication of the thermometer may be relied upon; and since that shows but a *trifling* increase of heat, although the pressure of the steam is *vastly* increased, high steam must be the thing." At such a conclusion those will arrive who prefer the indistinct light furnished by your correspondent's reasoning on the subject to the brilliant ray of true science which illumines the pages written by the philosopher Black.

(TO BE CONTINUED.)

[For the American Repertory]

ERICSSON'S TRANSVERSAL SHIP-PROPELLER.

The article inserted in the miscellaneous pages of the last number of the American Repertory, on the "Patent Screw-Propeller," being calculated, if left unnoticed, to lessen the confidence placed in an invention which is just being carried

into practical operation in this city, and which bids fair to secure great advantages to the commercial world, viz. Ericsson's Transversal Ship-Propeller; a few words in explanation of this invention are equally due to the parties interested as to the public.

This invention is by many confounded with the screw propeller of the experimental steam-boat Archimedes; there being however no other similarity than the effecting the propulsion by *oblique action*.

The propeller of the Archimedes consists of a screw or spiral blade, making precisely one turn round the axis, resembling in every respect the well-known Archimedian screw used in Holland and Germany for raising water, with the only exception that instead of revolving within a cylindrical box like the latter, it revolves in a square opening made in the "dead wood" of the vessel. The Transversal Propeller, on the other hand, consists of a series of spiral planes or plates attached to the circumference of a short cylinder, or broad hoop, made of wrought iron, supported by spokes, which are also of a spiral or winding form. When applied to ordinary sailing vessels, two of these propellers are used, one on each side of the sternpost, revolving in contrary directions, vertically but transversely to the line of the keel, their axes passing through the run of the ship, and being supported by braces secured to the sternpost. When applied to steam vessels built for the purpose, a single propeller is used, working in a narrow vertical space between the rudder and the sternpost.

It will be recollected that some time ago an iron boat was imported from England, by Captain Stockton, originally constructed for the purpose of proving the power and utility of the Transversal Propeller. This iron boat, with its machinery, after having been practically tested in England, has been for sometime in active operation on the Schuylkill and Delaware, as a tug, and its effect has been proved to be such that no reasonable doubt can be entertained as to the success of the plan. Capt. Stockton, with his known zeal in naval matters, accordingly proposed to the U. S. Government, about twelve months ago, to build a steam frigate of large dimensions, to be fitted

with the Transversal Propeller; and it will be recollected that the Secretary of the Navy recommended that plan to Congress last session. The subject having been so favorably received by the Navy Department and one of the chief features of the Transversal Propeller being that of working entirely under water, out of reach of shot, it is confidently anticipated that the plan will be speedily carried into effect for war steamers.

The practical application of the invention in this city, before alluded to, refers to a packet ship, to which the Transversal Propeller is now being applied, by the enterprising and intelligent Messrs. Stephen and Russell Glover. In such hands the practical advantages of the plan, as relate to the important application to sailing vessels, cannot fail to be fully developed. The machinery, consisting of the double propeller, and two engines of 35 horses power each, weighing in all 20 tons, is building at the Phœnix Foundry, and will be ready by the end of this month.

The correspondent of the London Mechanics' Magazine, in asking "what sort of a figure one of the trans-Atlantic steamers would cut with a screw (propeller) in her stern, when met by such gales as the Great Western and the British Queen have to contend with," plainly shows that he has no correct knowledge whatever of the subject on which he volunteers to give such decided opinion; for it is in this very instance that a propeller the principle of which is that of working entirely under water, and thereby, as we shall presently prove, not subjected to the disadvantages attending the paddle-wheel, from heavy sea or excessive immersion, will "show off" to the greatest advantage, and "cut the best figure."

Any ordinary observer, who has been at sea in a steamer during a gale, must be convinced that the paddle-wheel, however perfect it may be for rivers and smooth water, is the most inefficient propeller for ocean navigation that can well be conceived; for, during a gale, the speed of the engines generally become reduced to one half, so that an engine of 400 horses power is at once reduced to 200 horses; but even this power is by no means employed in urging the ship forward, fully one half being wasted by the unfavorable action and deep immersion

of the paddles. Thus, at a time when most power is wanted, we find an engine of 400 horses power reduced to that of 100 horses *effective* force. Besides this radical defect, there is the enormous waste of fuel, occasioned not only by the stated unfavorable action of the paddles, but also because the steam is never worked expansively in such circumstances: hence, the power expended, compared to the *useful* effect produced, will be in the ratio of nearly 3 to 1. Thus much for the supposed efficiency of the paddle-wheel.

Now, let us consider what is likely to take place by substituting the Transversal Propeller, constructed to work entirely under water. The immediate effect of the sea and the motion of the vessel on this Propeller, will evidently be two-fold, viz. the Propeller will either be submitted to an excess of immersion, or it will, in a very heavy sea, be lifted half out of water: in the first case no effect whatever on its speed or propelling power will be experienced, since its very principle is that of working entirely under water. Now, whether the immersion at the top of the Propeller be 4 feet or 10 feet, can make no difference, the specific gravity of the fluid being (in a practical point of view) the same in both cases; thus unlike the paddle-wheel, which loses its efficiency, and occasions an enormous loss of power when deeply immersed, the Propeller continues uniformly effective at any degree of excessive immersion, whilst, from obvious reasons, that increased immersion can in no manner be attended with waste of power. It is also worthy of notice that the excess of immersion of the paddle-wheel, so injurious, is not only produced by heavy sea, but also by the heeling as well as the rolling of the ship: these latter causes producing no effect whatever on the Transversal Propeller, in consequence of its revolving on the longitudinal axis of the vessel

With regard to the ascending motion, it will be seen that when the Propeller is lifted half out of water, its force to urge the ship forward will not be reduced, for as soon as the resistance of the water against the spiral planes becomes less, by the diminished surface presented, the speed of the Propeller will increase until a resistance is established equal to the moving force: the practical effect therefore of the reduced immersion

will be an increase in the speed of the engines; but this increase will not be very considerable, for the resistance of the water against the spiral planes will increase as the square of the velocity.

Experiments, made to ascertain the actual speed of the vessel compared to the progressive motion of the spiral planes, prove that the difference does not amount to 10 per cent. Thus, supposing the Propeller to be half out of water, it will unquestionably continue to urge the vessel forward with undiminished force; but there will be an increased speed of the engines in the ratio of $\sqrt{10+10} : \sqrt{10}$, or nearly as 4 to 3. Careful observation however of the motion of a vessel at sea has established the fact, that a propeller, the top of which is placed below the surface of the water to a depth equal to one fourth the draught of water of such vessel, will not be kept half out of water for more than one fourth part of the whole time, thus reducing the apparent loss of 25 per cent to only 8 per cent. This fact contrasted to what has been before stated respecting the immense loss attending ordinary paddle-wheels, will give the very best idea as to what sort of a figure a trans-Atlantic steamer will ere long cut with a transversal propeller in her stern. To this add the effect of a stiff breeze on the beam of a ship, with this Propeller, carrying a heavy press of canvas—and compare the result, either in point of speed or saving of fuel, to that attending a common steam vessel, which in similar circumstances would have the lee paddle half under water.

The great interest excited, both in the mechanical and commercial world, by the various reports circulated for and against the performance of the Archimedes and the screw, induces us to add some remarks on the theory of this propeller, formerly transmitted by the writer of this article to an English scientific journal, but the truth of which, experience since gained has only tended to corroborate: we are therefore convinced that the information which these remarks convey will not be unacceptable to the readers of the American Repertory.

The screw, as constructed by Mr. Smith, for propelling vessels, has several great defects, which will altogether prevent it from competing with the common paddle-wheel, both in point

of utility and economy of power: indeed, if we except war purposes, for which it is very essential that the propeller should be placed under water, regardless of an undue expenditure of power, we do not believe that it will ever be *practically* applied.

Any propelling apparatus, to be practically useful, must have for the basis of its construction such a principle, that the power applied to it will produce the greatest possible effect attainable, with reference to the specific gravity of the fluid in which it works; and it must also admit of considerable variation in the draught of water of the vessel to which it is applied. In both these principal features, Mr. Smith's screw is quite defective.

With regard to power and effect, there are three chief causes productive of much waste, *besides* the loss produced by the receding of the water, common to all modes of propelling, and which loss Mr. Smith admits to be in his screw equal to $\frac{1}{6}$ of the force applied: that is, the speed of the vessel to be $\frac{5}{6}$ of the progressive speed of the screw. The three causes alluded to consist of—

1. The friction or adhesion of the water, occasioned by the enormous speed of the circumference of the screw or spiral blade.

2. The unfavorable action of the blade towards the centre of motion, where it becomes nearly parallel to the line of direction in which the ship moves.

3. The friction attending the complicated and cumbrous gear-work resorted to, in order to produce the requisite high velocity of the screw.

To give our readers an idea of the amount of power wasted by the excessive velocity of the spiral blade in going through the water, we will only suppose the slow speed of $8\frac{1}{2}$ knots obtained by the "Archimedes," that is, less than 10 statute miles per hour: we will say, for round numbers, 10 miles. or $10 \times 5280 = 52{,}800$ feet per hour, or $\frac{5280}{60} = 880$ feet per minute.

Mr. George Rennie states in a letter, which has been published, that two different screws have been applied to the Archimedes: one, 7 feet in diameter and 8 feet long; the other being 6 ft. diameter and 7 ft. 6 inches long: the circumference

of the latter requiring the least speed of the two, we will found our calculations upon the dimensions thereof.

The loss of speed being admitted to be $\frac{1}{6}$, it follows that for each revolution of the screw, the progress of the vessel will be $\frac{5\times7.5}{6}=6.25$ feet: hence, the number of revolutions requisite to produce 10 miles an hour, or 880 feet per minute, will be $\frac{880}{6.25}=140.8$. The diameter of the screw being 6 feet, the circumference 18.85, and its length being 7.5 feet, with exactly *one turn*, it follows that the length of the circumference of the blade will be $\sqrt{18.85\times18.85+7.5\times7.5}=20.3$ feet; this, multiplied by the number of revolutions, gives $(140.8\times20.3)=2858$ feet per minute, or $\frac{2858}{60}=47.6$ feet per second: hence, in order to propel a vessel at the rate of *only ten miles* per hour, a velocity of upwards of 32 miles per hour must be given to the screw! That a large surface cannot be moved through the water at such an enormous speed without much resistance, any one will suppose; but the amount of the actual loss none of our readers would perhaps credit. We have, however, accurate data for forming an estimate, by the known adhesion or friction of water against a given surface, at any given speed. Col. Beaufoy ascertained that a smooth surface, containing 50 square feet, met with the following resistance:

At	3	feet	per second	.....	1.588 lbs.
"	6	"	"	.....	6.237 "
"	9	"	"	.....	13.810 "
"	12	"	"	.....	24.195 "

By inspecting these figures it becomes manifest that the resistances increase exactly as the square of the velocities; and therefore when the resistance at 12 feet per second is 24.2 lbs. it will be 380 lbs. at 47.6 per second, or $\frac{380}{50}=7.6$ lbs. per sq. ft. Now, in the screw under consideration it will be found that the mean of the friction or adhesion against *both sides* of the screw or blade will be very nearly equal to that offered to a surface

of 40 square feet moving at equal velocity to the circumference: hence, $40 \times 7.6 = 304$ lbs. will be the adhesive resistance at a velocity of 2858 feet per minute, or $2858 \times 304 = 868{,}832$ lbs. raised one foot high in a minute, which is equal to $26\frac{3}{10}$ horses power to be exerted by the moving force without producing any useful effect. The power of the engine being 90 horses, and the loss produced by the receding of the water admitted to be $\frac{1}{6}$, or 15 horses, it follows that $15+26=41$ horses power are wasted, to say nothing of the loss occasioned by the multiplying gear, and by the unfavorable action of the screw or blade towards the centre, before alluded to. Our readers will, after this demonstration, understand why the speed attained has only been $8\frac{1}{2}$ knots per hour in open water, with 90 horses power applied to a vessel of such beautiful lines as the Archimedes.

The lamentable consequences of the explosion of the boilers of the Archimedes may also be traced to the cause we have now explained, viz. the great resistance produced by the excessive velocity of the screw; for, had not this unlooked-for resistance operated, the power of the Archimedes's engines would have been ample to give the required speed, without raising the steam in the boilers above the ordinary and safe pressure.

MECHANICUS.

New-York, Nov. 16th, 1840.

MECHANICS' INSTITUTE.

The first of the course of lectures before this society, for the season of 1840—41, was delivered on Monday evening 16th November, by J. L. Chester, Esq. His subject was "The Aborigines of North America"—a theme at all times of exceeding interest, and the more so, now that it is receiving much attention from the poet and historian. The lecturer treated it in a manner that produced the strongest manifestation of pleasure from his audience. For the gratification of those of our readers who were prevented from hearing the lecture, we present a synopsis of it, interspersed with a few extracts.

The lecturer first directed the attention of his audience to the contrast between the condition and appearance of this

country three centuries and a half ago, and its present appearance. To bring the matter nearer home, he eloquently said :—

"Let us see nothing but this one island on which we live, and on which now stands and flourishes—aye, and shall stand and flourish—the proudest city in the universe! It is exceedingly difficult to imagine that, but a comparatively short time ago, this island was covered with a mighty forest; that the smoke of the Indian wigwam arose and mingled with the same atmosphere that now floats above us, and that the face of a white man had never been seen by the red people who inhabited it: yet such is the fact. Aye, throughout our goodly streets, when they were but mere hunting paths, hath the brave Manhattan stalked in his gravity; within our beautiful parks have the maidens of his tribe frolicked and gamboled; beneath our very feet hath the 'birchen canoe' danced upon the waters, and before our very hearths have the tawny urchins sported in their childish glee. Look out upon this scene of busy life, and then go back, if you can, to the time when the Manhattanese and the deer were the only dwellers on this isolated spot. And stop not here. Fancy this but a miniature of the whole state: think of our mountains and valleys, our plains and endless forests, teeming with human life, and remember that every being whom you see hath a red face. And stop not at the 'Empire State.' Journey to the Gulf of Mexico on the south, and to the Pacific Ocean on the west, and the picture is the same. An Indian's face is peering from behind every tree; his canoe floats on every river and lake; the council fire is blazing on every prairie, and a wigwam is standing on every hillock. Thousands and millions did they number—and where are they now?

"They are conquer'd—they have vanish'd—and the white man's seal is set
Upon the mournful mandate, that with manly tears is wet;
And the clash of meeting combatants proclaimeth every day,
That the hated name of Indian fadeth rapidly away."

Mr. Chester then announced the divisions of his lecture as follows:—

1. The origin of the North American Indians.
2. Their general character and past history.
3. Their present condition.

Under his first division the lecturer briefly reviewed the various speculations concerning the origin of the Indian race. He first noticed the common opinion that this country was at one time the abode of a race partially civilized, to whom is attributed the erection of the ancient mounds of the West, and who are supposed to have been driven southward or totally destroyed by the Indians on their first migration to America. He showed that there are quite as many arguments in favor of the assertion that the character of the Indian race has deteriorated, and that we must attribute to the ancestors of the existing tribes the

erection of those stupendous monuments. An important one that he adduced is the fact that the long-cherished speculation, and now settled conviction, that these works were erected for military purposes, is likely to be proved erroneous, through the influence and by the research of the corps of geologists of the state of Ohio, the topographer of which, Col. Charles Whittlesey, is particularly entrusted with their examination, and has already expressed his firm conviction to that effect. He also mentioned the discovery of the remains of a race of men, in ancient tombs possessing great architectural beauty, among the mountains of Peru and Bolivia, the anomalous appearance of whose skulls are precisely like those of the Flathead Indians of the West. He also referred to one peculiarity in the Indian character, as supporting this idea:—

'The speechless gravity and almost sullen obstinacy which is universally displayed, would seem to denote that they were spirit-broken, in consequence of having fallen from some higher estate, and that they were continually musing upon their misfortunes, and contrasting their former grandeur with their present degradation."

Under this division Mr. Chester also noticed the idea entertained by some, that "the Indians of North America are the immediate descendants of the lost tribes of Israel, who, after various wanderings and pilgrimages, at last found their way across Bhering's Straits, and populated the wild regions of the western continent," and mentioned some of the arguments of its supporters. He remarked, that the examination of these speculations would not be attended with any results productive of profit or additional light, and that it far better becomes us to employ ourselves in cultivating our sympathies, and in ameliorating as far as lies in our power the wretched condition of this abused and ill-fated race.

Under his second division, Mr. Chester first gave a concise and clear account of the social and international polities of the Indian nations; contrasting them with the petty states of the eastern kingdoms; showing that under their simple government the tranquillity of their little communities was far greater than that of any civilized city; drawing a contrast between the manner in which their chiefs obtained their authority, and that in which "the wiser and more wily politicians of the present

day" reach their official stations; and particularly noticing the singular position which the females held among the tribes. He showed that the Indians were familiar with many of the rules of international polity, and that in fact there is scarcely a refinement in the diplomacy of civilized nations with which they are unacquainted. He then briefly noticed those characteristics peculiar to each individual, and yet so general as to be the characteristics of the whole race. These were their religion, education, language, oratory, poetry, relative position of the sexes, chastity, perception, retention, generosity, and revenge. These were all stated and described in a forcible and amusing manner, interspersed with appropriate illustrations that increased the innate interest of the subject.

He then briefly reviewed the manner in which the American government became possessed of the lands of the Indian, and the legal tenure by which they are held, and stated that this would form the basis of his next lecture. In conclusion, he gave a lucid and feeling sketch of their present condition; reprobated in the severest terms the treatment of the Seminoles; noticed the attempts of the missionary to instruct the Indians in the religion of the Bible; and expressed his decided conviction that some great national calamity would be our punishment for our course of abuse and injustice towards this people.

[For the American Repertory.]

ON THE CENTRIFUGAL PUMP.

BY EDWARD CLARK.

I noticed some years since, in a work treating on hydraulics, the title of which has escaped my recollection, a diagram and description of a centrifugal pump. It was made by attaching two pipes, somewhat in the form of the letter V, furnished with valves at their lower ends, to a perpendicular shaft, set in a reservoir of water, so as to allow of the pipes dipping slightly into the fluid. This shaft was supported by means of appropriate frame-work, and had a crank or pulley secured to its upper end. Thus arranged, the pipes, upon being filled with

water and the shaft made to rotate rapidly, delivered continuous streams from their upper orifices. The rationale for this, as there given, was, that the columns of water in the pipes served as pistons, and were ejected in unbroken streams by the simultaneous action of the centrifugal force at the divergent ends of the pipes, and atmospheric pressure on the water at their convergent ends.

On reflection, it occurred to me that the cause of the action of this pump had been mistaken. With a view to test it, I made several experiments; and they resulted in establishing the fact, that atmospheric pressure exerts no agency in their operation. The action of the pump depends entirely on the centrifugal force exerted upon the fluent water, unless the adhesive attraction of the particles of water to each other be a coägent in producing the effect.

The position I have advanced may be verified, by simply removing a longitudinal section from the pipes, and omitting the use of the valves. A pump thus constructed will be found to deliver water very well, and, I have no doubt, much better than where valves and close pipes are used.

The utility of this variety of pump—I mean the first described—has been questioned; and, for ordinary purposes, I think, very justly. But there are many situations where its application would be productive of benefits; as for instance: in distributing water from a spring or pool to proximate grounds; in draining and irrigating lands; and in evaporating ocean water for the purpose of manufacturing salt. And what, in my opinion, enhances the value of this pump is, that every practical farmer may make it himself. Nothing more is required than a leader or trough excavated from a piece of small timber, or made by nailing two pieces of boards together, and then securing them to a perpendicular shaft, as before described. The quantity of water which such a pump will deliver must of course depend upon the number and size of the troughs used, the angle of their divergence, and the rapidity of the rotary motion imparted to the shaft or pump. The propelling power may be wind or water, accordingly as they may be at command. With open pipes, one or more pumps of this description may be attached

to the same shaft. In such case the pipes should at their upper ends be curved a little upward, so as to deliver the water as near as may be in unbroken streams, into an annular trough placed some short distance above the termination of the pipes, whence it may flow into an annular reservoir, supported from the surrounding frame-work, and from which another series of pipes or a pump of similar construction may be supplied. But a pump so constructed would embrace more of fancy than utility, where other means are at hand for elevating water.

For the American Repertory.

THEORY OF THE TIDES.

BY OLIVER SMITH.

To understand the tides correctly, the law of gravitation must be borne in mind, viz. that one body of ponderable matter attracts another as the square of its distance from that other *inversely*, and as its own quantity or mass *directly*.

Now, it is known (see Cambridge's Astronomy) that the mass of the moon to that of the sun is about as 1 to 24,277,622½, and that the mean distance of the moon from the earth is about 60 times the semi-diameter of the latter, while that of the earth from the sun is about 23,987 of the same measure; and hence, their respective attractions will be as $1 \div (60)^2$ to $24{,}277{,}622\frac{1}{2} \div (23{,}987)^2$, or as 1 to 152 nearly: that is, the sun attracts the earth 152 times as much as the moon does; and in passing we would just observe, that if we divide this 152 by 68.4, which is the mass of the earth when the moon is unity, we shall have 2.22 nearly; showing that the sun attracts the earth 2.22 times as much as the earth does the moon. The effect of these attractions in producing tides upon the earth may be clearly understood by reference to the accompanying diagrams.

In Fig. 1, *M* is the moon, and *e* the earth; and the mean distance from the centre of the one to that of the other is, as we have already said, about 60 times the earth's semi-diameter; and hence, it will be 59 of the same measure from the centre of the moon *M* to the surface of the earth at *r*, and 61 of it to the opposite side at *g*; and it must be remembered that the moon

attracts the water away from the earth at r, and the solid earth away from the water upon the opposite side at g; for, as the solid portion of the earth hangs together, the attraction in question may be considered as applied to the centre e. In short, the whole of it must move alike in this case, and just as fast as e does; or this circumstance may be here wholly disregarded, and the earth considered as consisting entirely of water. Upon either supposition, if we call the attraction upon e unity, we shall have that upon $r=(60)^2\div(59)^2=1.03418$, and that upon $g=(60)^2\div(61)^2=0.96748$, which, subtracted from 1, leaves .03252; so that the tide directly beneath the moon will be to the opposite one as 34 to $32\frac{1}{2}$ nearly; and it will be perceived that the water, upon the same side of the earth with the moon, rises because it is drawn more powerfully than is the solid earth beneath it, while that upon the opposite side of the earth being drawn with less power than is the earth, rises in consequence of its centrifugal force.

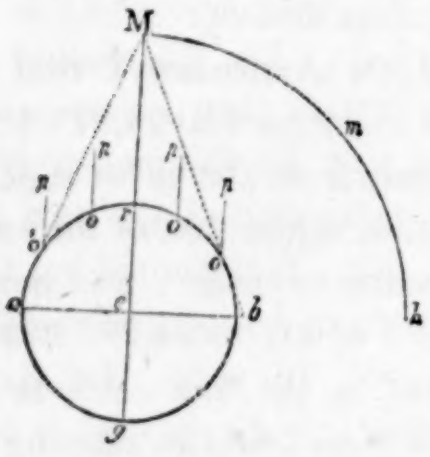


Fig. 1.

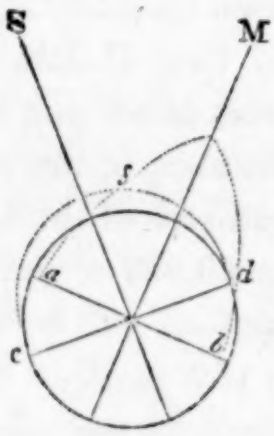


Fig. 2.

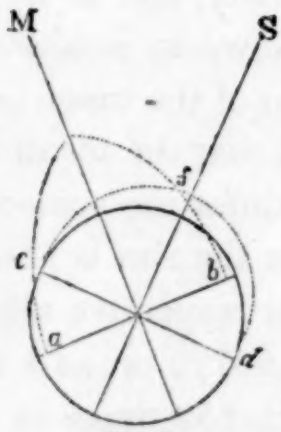


Fig. 3.

Again. As the distance of the sun from the centre of the earth is about 23,987 times the semi-diameter of the latter, if we call the attraction of the sun upon e, Fig. 1, unity, we shall have that upon the surface, say at $r=(23{,}987)^2\div(23{,}986)^2=1.00008$, and that upon the opposite side at $g=(23{,}987)^2\div(23{,}988)^2=0.99992$, which subtracted from unity leaves .00008; so that, owing to the great distance of the sun, the two tides which it raises daily upon the surface of the earth will not be found to differ until we carry the division beyond five places of decimals. But, as we have already shown, the sun attracts the earth 152 times as much as the moon does; so that, multiplying this

fraction .00008 by 152, we have .01216; while the mean of the two lunar tides will be, as is shown above, about .033$\frac{1}{4}$; and hence it appears, as Bowditch mentions in his Navigator, that the lunar tide is something more than 2$\frac{1}{2}$ times, say 2$\frac{3}{4}$, as high as the solar one.

We have thus far considered the attractions to be perpendicular to the axis *a b*, and in the lines *o p*, &c; but in fact they will be oblique, as *o M*, *b M*, &c; and this will tend to increase the gravity at *a* and *b*, and to make the difference between the two diameters of the earth, *a b* and *g r*, greater than it would otherwise be. This effect, if any thing, will be as the natural sines of the paralaxes of the sun and moon; so that to the fraction .034, which indicates the lunar tide, we shall for the moment add .017, which will increase it to .051; to that of the sun we shall add .00004, which will increase it to .00012; and this, multiplied by 152, will become .01824; that is, making this allowance, we have the lunar to the solar tide as 51 to 18, which is about the same as it was before. But this should not be done; for if the particle at *o* meets with obstruction in the direction *o r*, it will not rise so high as *p* on the oblique line *o M*; so that, whatever is gained by the contraction of the axis *a b*, will be lost—or nearly so—in that of *g r*. Not perceiving that any allowance should be made in this case, I return to the first relation of 12 to 33$\frac{1}{4}$, or about 1 to 2$\frac{3}{4}$. In short, the above correction, which seems at first thought to be proper, would here be wholly superfluous under any circumstances; for, whatever is gained or lost in the lunar tide, by the oblique motion in question, is proportionally so in the solar one. La Place's solution of this problem is not at my command, and his formula, as given by Herschel, I confess, does not appear to me lucid, and, I am a little suspicious, it did not to Herschel himself.

Again. As the moon passes from *M* to *m* toward *h*, Fig. 1, around the earth, it lets go the waters at *o'*, and the same or a portion of it runs down to meet the tide which will be at *a*, when the moon shall have passed down to *h*; and hence it appears that a part of one tide is constantly flowing in an eastwardly direction, and meeting the next one which is coming at

any place; and hence the reason why the tide is always further to the east than is the moon which has raised it: that is, the current in question will give to every tide a relative *eastwardly* motion by checking its *westwardly* one, and thus cause the highest point of the same to be further to the eastward than it would otherwise be. Furthermore, from what we have said it will be perceived why there should be, as we actually find, a current of water setting to the north-west, through Bhering's Straits, and around the northern point of this continent; and were it not for the strong south-westerly winds which prevail so much upon the western coast of South America, we might look for a similar one around Cape Horn. Still further: we perceive why there should be, as we find, a current around the Cape of Good Hope; and another one, though it is modified by the trade winds and called the Gulf Stream, in the Atlantic Ocean. The current which sets in at Bhering's Straits, comes out again by Davis's Straits, and, acting with the Atlantic tides, forces a great quantity of water into the Bay of Fundy; and a portion of the same current, as Mr. Redfield justly observes (19th vol. Franklin Journal of Science) continues along between the Gulf Stream and our coast, much further south than New-York.

Now, suppose the tides to increase in height, from the lowest to the highest, as the numbers 1, 2, 3, &c.; and suppose that one tenth of one tide finds its way to increase the next one that is coming. The first tide then would be 1^a, and the second 2.1^b, and the third 3.21^c, &c. which numbers are lettered in order that they may be conveniently referred to. On the sixth day, which will bring the moon from quadrature nearly to conjunction with the sun, or in opposition to him, or, in other words, to the *syzygy*, the tide, by this rule will be 6.54321^f; and the next day it will be 7.654321^g; and the day following it will be $6.7654321^{f'}$, which is a little more than one tenth higher than was the one which is marked ^{f} immediately previous to the syzygy; and so the second tide *after* the syzygy will be greater than was the second in the retrograde order *before* it; and so on. We shall now look at another reason why the next tide after the syzygy should be greater than is the one which occurs precisely at that time.

In Figs. 2 and 3, *c f d* represent the solar tide, and *a f b* the lunar one, which rises higher and more abruptly than does the other. In Fig. 2, the sun *S*, before the new moon, is seizing, while the moon *M*, is relinquishing the water at *f*, and, consequently, causing the difference between the two tides to be *less* than it would otherwise be; but in Fig. 3, the moon *M*, just after the conjunction is seizing, while the sun *s*, is relinquishing the water at *f*, and thus causing the difference between the two tides to be *greater* than it would otherwise be; and hence we perceive a double reason, or two causes, why the next tide *after* the syzygy should be higher than is the one which takes place precisely at that time. Nor am I aware that any one has ever pointed it out before. The indefinite remark is common enough in works upon astronomy, that the flow of the water continues after the cause which put it in motion has ceased; but this was never a satisfactory explanation of the phenomenon in question.

Mr. Whewell, of England, is reported to have said, in one of his public addresses, that it does not appear that the tides are what, according to the theory upon the subject, they ought to be; but I am not aware that he has told us wherein they are not so. For myself, I think differently. I think they prove to be just what the laws of universal gravitation require.

It is said that the velocity of the principal wave of agitated water, upon or near the surface of the earth, is equal to that which a body would acquire in falling through half the depth the same fluid: if this is so, I should like to see the demonstration from some correspondent of the Repertory.

For the American Repertory.

ON THE STEAM-ENGINE.

(CONTINUED.)

We stay our remarks upon the improvement of the steam-engine, to narrate the following curious circumstances, which will be found of at least a corresponding interest with the detail of the electrical properties of steam, transmitted in the *London

*The article referred to by our correspondent will be found at page 368 of the present number.—*Ed. Rep.*

Philosophical Magazine and Journal for November, and which will also help to maintain a balance between the scientific communications of England and America.

We should not have alluded to these circumstances so early, had not a statement been called for on the instant of their discovery, in vindication of the character of individuals, who have for some time been unjustly and injuriously affected by them: an explanation, then, is doubly required, and we trust will be found as serviceable in a commercial as honorable in a moral or creditable in a scientific view of the subject. We hasten, then, to our narrative.

In Jan. 1838, a new wrought-iron wagon boiler, with internal furnace and flues, to which alone the heat was applied, was furnished to the steam-boat Pluto, of the ferry from New-York to Hallett's Cove, and with few intermissions it was in use for about 16 months.

This boiler was supplied, at will, with the sea-water from the estuary in which the boat floated, or from a fresh-water spring on the New-York shore, for which purpose the boat was furnished with a hose and tank, and the engineer directed to use fresh water on all possible occasions.

About six months since, a new and larger boat was placed upon the ferry; and the boiler of the Pluto having been found very leaky, was examined, pronounced incapable of repairs, and cut to pieces without further investigation; being reported of very bad iron, and, as we shall find, subjecting to unmerited reproach the talented engineer, who had engaged to construct the boiler of the best Pennsylvania charcoal iron.

Subsequently we were requested to examine this boiler; but it had disappeared: several pieces of it, however, were shown to us, and their appearance was as follows:

Those parts exposed to radiant heat and to heated air were comparatively and generally but little injured; that is to say, the injuries were principally local, confined to small, distant and distinct places. Of the upper part, or shell, we saw nothing, and heard no complaint; but several pieces of the bottom of the boiler were perforated with holes, and the contiguous parts wasted or eaten away, in an irregular manner, for one or

two hands' breadth, at each place, so that some considerable part of the iron surrounding the perforations remained in laminæ, and of various thickness, decreasing to that of a shilling or less, while the whole we saw of the bottom was much though irregularly reduced in thickness; and we were informed that the lower portions of the sides of the boiler were similarly reduced. Reflecting upon these circumstances, we informed the proprietor of the boat that we considered the injuries to have arisen from combined galvanic and chemical action, rather than neglect or dishonesty on the part of the boiler maker, inasmuch as we were at a loss to explain how such sudden and extensive action could have been otherwise produced; and as he stated that the new boilers both in the Pluto and in the new boat were constructed and situated very like the former ones, we confidently anticipated a similar and injurious action upon them. A few days since, we went purposely to inquire how matters progressed, when the proprietor informed us of the occurrence of a new and distinct difficulty: the copper sheathing upon his new boat, although running only six months, was very extensively destroyed, and he gave us a small portion of it, about a superficial inch, for analysis, suspecting the cause of this destruction to be the bad quality of the copper.

This piece presented distinct laminated surfaces, some of which had been dissolved away so as to disclose their edges. Analysis proved it free from any alloy of iron, tin or lead, and but slightly alloyed with zinc. Now, just such an alloy has been patented in England, and described as more durable in sea-water than pure copper; and as this metal has been here found so incomparably less durable than even the common impure commercial copper sheathing, it seems undeniable that its rapid destruction must have arisen from a new modification of the same action which destroyed the iron boiler of the Pluto.

But the galvanic destruction of copper, in metallic and water connection with iron, seems contrary to facts stated, and to the order ascribed by chemical writers of the action of these metals on each other in galvanic connection, in which the iron is always stated to be the more destructible of the two, and to act as a perfect protector to copper; so that when the

boiler of the Pluto, being in double connection with the copper sheathing of the boat, was destroyed, it was consonant with the opinions of all chemical writers, from Sir Humphrey Davy down to the latest authority—Turner—upon the subject; while the destruction of copper, when in metallic and fluid connection with iron, which latter, so far as can be seen, remains unimpaired, is contrary to the recorded opinions of all writers.

We think, however, this seeming theoretic difficulty admits of easy explanation, and is consonant with observed facts: it somewhat resembles, and is therefore in a degree corroborated by the galvanic action of a single plate of zinc, subjected to the action at the same time of different solvents applied to its two sides, as described in Turner's work, fifth edition, page 89.

We never hesitated to ascribe the galvanic action in the first boiler to the corroding action of sea-water occasionally introduced, notwithsanding the general employment of fresh water for evaporation; for the various saline matters in sea-water not being volatile, in time form in the cooler part of the boiler below the flues, a concentrated solution, which is assisted in its corroding effects, probably, even by the lower temperature of the water supplied to the boilers at the bottom, while the flues, from being the part alone heated, have been far less injured.

All the writings of chemists, when examined in relation to the destruction of iron and preservation of copper, suppose the two metals to be at the same time exposed to the same dissolving fluid. Now in the present case, the copper is exposed to the intense dissolving power of chloride of sodium, while the iron of the boiler is very carefully kept in contact with fresh water only—at present unexamined; hence, the former conditions being reversed, we need not be surprised at the result being reversed also, although perfectly unexpected, and directly contrary to the notions generally inculcated. Hence then it appears, an acquaintance with science would not harm even a boiler maker; and that self-sufficiency and conceit in any man, without necessary education, and without information on an important and powerful action, hitherto unobserved, and therefore unstudied, can only lead to error, discreditable reflections, and to other lamentable results. † †

THE FINE ARTS.

We were much gratified, a few days since, by a visit to the studio of Thomas S. Cummings, Esq. The merits of this gentleman as an artist are well known, and he has long enjoyed the first reputation in his particular line of art.

A miniature portrait of the Vice President of the Mercantile Library Association, just finished, is really a *breathing likeness.* The very sinuosities of the face and peculiar points of character surpass any of the artist's former works—which is the highest praise we are capable of expressing. It is entirely free from the waxy softness so common with miniatures, and still exhibits a degree of finish rarely attained with so much depth, force and apparent action. The masses of hair are represented as nature made them, and free from the staid, barberized appearance which extravagantly high lights usually produce. The back ground and accessaries are of the same stamp, and fully bear us out in asserting, that we have seen inferior pictures by Malbone, Robertson, and others, sold as choice specimens of the art at four times the prices charged by Mr. C.

A composition, called the *Bijou*, we have never known surpassed, except by the miniature spoken of above. The design and expression are agreeable: the drapery and accessaries, which are extensive, possess all the freedom and flowing elegance which would be produced by the best masters in oil. Notwithstanding its many beauties, we prefer the individuality of a portrait.

T. C. Cole, N. A., has just finished a series of allegorical pictures, called "The Voyage of Life;" and they not only sustain his previous reputation, but surpass all former works from his hand.

The first picture represents *childhood.* On the left is seen, in the side of a precipitous mountain, a dark cavern, from which issues a boat composed of figures of the hours, bearing within it a child, the *voyager*, sporting amidst flowers, with which the boat is filled, and guarded by a celestial being, who has the helm. The banks of the river are covered with a luxuriant

growth of flowers, and the rosy light of morn streams o'er the landscape. The sky is aërial; the flowers harmoniously arranged, and in picturesque groups; the figures beautifully composed, and the whole picture impresses the spectator with the conviction that it is a representation of the glowing beauties and pleasures of early childhood.

The second picture represents *youth*. This is truly a magnificent landscape, and shows nature as she ever is in early summer, "in brilliant green." The trees and mountains seem bursting with luxuriance, and the cool coloring of the river adds much in effect to the scene. The voyager has now taken the helm in his own hand; his eyes steadily gaze at a youthful phantasy, a "castle in the air;" the body bent forward, as if from an impatience to surpass even the boat in speed; the spirit has left him, bidding "God speed;" and with all the vivacity and eagerness of youth he turns his energies toward the single object of his aspirations, carrying with him the spectator's involuntary desires for his success. In this picture, the river, while yet in sight, turns suddenly in another direction, and precipices and rapids seem to portend certain destruction to the voyager for his precipitancy.

The third picture, which represents *manhood*, we were partly prepared for by the second picture; but the fancy of the artist has outrun our untutored conceptions. The river rushes through a rocky pass toward the distant ocean; tempest and gloom pervade the scene; the boat is about to dash down a cataract, and the destruction of the voyager seems inevitable. His immediate atmosphere is filled with demon forms; the whirling clouds, trees torn by the winds, the rush of waters—all show how vain are his unaided efforts to avoid the doom impending. But he is not deserted; for above all, sits his guardian spirit.

The fourth picture represents *old age*. We now see the voyager seated in the boat; the figures of the hours defaced and broken; the tiller, and the emblem of time at the prow, both gone; darkness and gloom o'erspread the ocean. The suppliant old man feels his helplessness, and with uplifted hands implores the assistance of Heaven. The spirit is with him, and points to a burst of golden light, on the rays of which

angels are seen descending, to bear the penitent to the realms above. This picture possesses breadth and quiet grandeur to an extraordinary degree.

We cannot close our remarks without according to Mr. Cole strong praise for unusual excellence in the general tone of these pictures. He has successfully avoided the *russet* tone, so common in landscape or the gorgeous colors of decaying nature. We cheerfully allow the beauty of autumnal tints; but we also object to nature always being represented in a state of decay. Mr. C. has ventured to paint her in full health, and well has he succeeded.

NOTICES OF NEW PUBLICATIONS.

Applications of the Science of Mechanics to practical purposes. *By* JAMES RENWICK, *LL. D.* New-York: Harper & Brothers.

In this country where a practical knowledge of the more important mechanical principles are considered necessary to the completion of even an ordinary education, such works as the one before us must ever prove desirable. We cheerfully recommend it to those who may wish a well-selected set of first principles, so illustrated and explained as to make them perfectly intelligible to the general reader.

Life of Commodore O. H. Perry. *By Lieut.* A. S. MACKENZIE, *U. S. N.* *Illustrated with a fine engraved portrait by Dick, from Jarvis's masterpiece in the possession of the Corporation of New-York.* 2 vols. 8vo. New-York: Harper & Brothers.

The memory of the true hero of Lake Erie (J. F. Cooper, Esq. to the contrary notwithstanding) will ever be cherished by the American people, and this concise history of his exploits has done him full justice. This work constitutes No. 107 and 108 of the District School Library.

Life and Adventures of Bruce, the African Traveler. *From the last London Edition.* New-York: Harper & Brothers.

This interesting abridgment of Bruce's large work is illustrated with a portrait by Dick, in his best style. Notwithstanding the doubts which have been sometimes expressed relative to the accuracy of Bruce's description of Egypt, we are inclined to believe that, as a whole, his representations are much more accurate than those of many of his enemies. No. 121 of the District School Library.

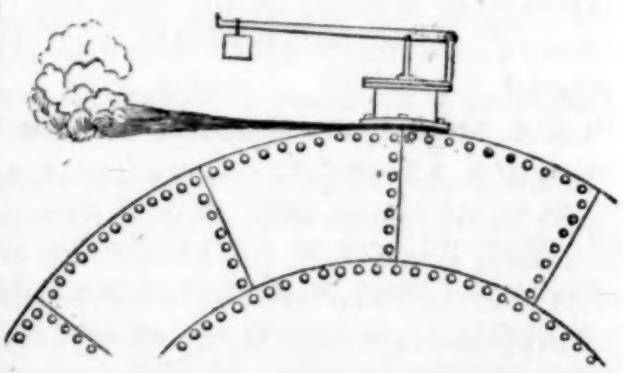
History of the United States, from their First Settlement as Colonies to the close of the Administration of Mr. Madison in 1817. *By* SALMA HALE. 2 vols. 8vo. Being Nos. 96 and 97 of the District School Library. New-York: Harper & Brothers.

We have long been in want of such an abridged history as that presented by Mr. Hale, and we sincerely hope a third volume may be added, *posting up* the events of our government to a later date. The Appendix will be found to contain much statistical matter of much interest.

PROGRESS OF SCIENCE.

On the Electricity of a jet of Steam issuing from a Boiler. By H. G. Armstrong, *Esq. in Letters to Professor Faraday.* [Communicated by Professor Faraday to the London Philosophical Magazine.]

A few days ago I was informed that a very extraordinary electrical phenomenon, connected with the efflux of steam from the safety-valve of a steam-engine boiler, had been observed at Seghill, about six miles from Newcastle. I therefore took an early opportunity of going over to that place, to investigate the truth of what I had heard, and by so doing I have ascertained the precise facts of the case, which appear to me to possess so much novelty and importance, that I deem it right to transmit the particulars to you, believing that in your hands they will prove most conducive to the advancement of science. Without further preface, I shall proceed to narrate what I saw and heard on the spot.



There is nothing remarkable in the construction of the boiler, which is supported upon brick masonry in the usual way. The annexed sketch represents an end view of the boiler and safety valve, by which it will be seen that the valve is placed on the top of a small cylinder, having a flange round the lower end, which is fastened by bolts to the summit of the boiler, between which and the flange, a cement, composed of chalk, oil and tow, is interposed for the purpose of making the joining steam-tight.

About three weeks ago the steam began to escape at this joining, through a fissure in the cement, and has ever since continued to issue from the aperture in a copious horizontal jet. Soon after this took place, the engine-man, having one of his hands accidentally immersed in the issuing steam, presented the other to the lever of the valve, with the view of adjusting the weight, when he was greatly surprised by the appearance of a brilliant spark, which passed between the lever and his hand, and was accompanied by a violent wrench in his arms, wholly unlike what he had ever experienced before. The same effect was repeated when he attempted to touch any part of the boiler, or any iron-work connected with it, provided his other hand was exposed to the steam. He next found that while he held one hand in the jet of steam, he communicated a shock to every person whom he touched with the other, whether such person were in contact with the boiler, or merely standing on the brick-work which supports it; but that a person touching the boiler, received a much stronger shock than one who merely stood on the bricks.

These singular effects were witnessed and experienced by a great many persons, and among others by two gentlemen with whom I am personally acquainted, and who fully corroborate the above account, which I obtained from the engine-man.

The boiler had been cleaned out the day before I saw it, and a thin incrustation of calcareous matter, reaching as high as the water level, had been removed, and the consequence was, that the indications of electricity, though still existing, were very much diminished. Still, however, what remained was very extraordinary; for when I placed one hand in the jet of steam, and advanced the other within a small distance of the boiler, a distinct spark appeared, and was attended with a slight electrical shock.

From the effect produced by the cleaning of the boiler, it appears pretty obvious that the phenomenon is in a great measure, though not wholly, dependent upon the existence of an incrustation within; and the reason why such effects do not in any degree attend the effluxion of a jet of steam from a boiler in ordinary cases, must, I apprehend, be sought for in the fact, that in the present instance the steam escapes through an aperture in a non-conducting material, while in a vast majority of cases the escape must take place through a metallic orifice. Can the explosion of boilers, respecting the cause of which so much uncertainty at present exists, have any connection with the rapid production of electricity which thus appears to accompany the generation of steam?

In the present case the incrustation in the boiler is very rapidly formed, and I therefore expect that in a few days the effects will have become as strong as they were at first. Whenever this takes place, I shall again go over to witness them; and if you wish for any further information, I shall be glad to obtain it for you. In the mean time you are at liberty to make any use of this letter that you think fit.

Newcastle-upon-Tyne, Oct. 14, 1840.

Newcastle-upon-Tyne, Oct. 22, 1840.

I yesterday revisited the boiler at Seghill, in company with some friends, and took with me such apparatus as I deemed necessary for experimenting on the electrical steam. The results of this second visit I now hasten to communicate, and you will find in the following account of my proceedings, answers to all the queries you were kind enough to send me, for the purpose of directing my attention to the proper points of inquiry.

I found the boiler, and every thing connected with it, precisely in the state in which I have already described it, and on trying the steam in the same way as I did on the former occasion, the effect was very nearly the same; but when I placed myself on an insulating stool, the intensity of the sparks which passed between my hand and the boiler was greatly increased, as well as the twitching sensation in the knuckles and wrist, which accompanied the operation, and which in my former letter I designated a slight electrical shock. In pursuance of your instructions, I had provided myself with a brass plate, having a copper wire attached to it, which terminated in a round brass knob. When this plate was held in the steam by means of an insulated handle, and the brass knob brought within about a quarter of an inch from the boiler, the number of sparks which passed in a minute was from 60 to 70, as nearly as we could count; and when the knob was advanced about one-sixteenth of an inch nearer to the boiler, the stream of electricity

became quite continuous. The greatest distance between the knob and the boiler, at which a spark would pass from one to the other, was fully an inch. A Florence flask, coated with brass filings on both surfaces, was charged to such a degree with the sparks from the knob as to cause a spontaneous discharge through the glass; and several robust men received a severe shock from a small Leyden jar charged by the same process. The strength of the sparks was quite as great when the knob was presented to any conductor communicating with the ground, as when it was held to the boiler. It appeared to make very little difference in what part of the jet the plate attached to the conducting wire was held; but when a thick iron wire was substituted for the plate, the effect was greatest when the wire was held very near to the orifice. The valve was loaded at the rate of 35 pounds per square inch; but the pressure of the steam fluctuated considerably, which gave me an opportunity of observing that the quantity of electricity derived from the jet increased and diminished with the pressure. The electricity of the steam was *positive;* for when the pith balls of the electrometer diverged upon an instrument connected with the steam, they were attracted by a piece of sealing-wax rubbed on woolen cloth; and when a pointed wire was held by the person on the stool, under the shade of a hat, *a pencil*, and not *a star*, of electrical light became visible.

Besides the principal jet of steam which I operated upon, there were several small streams issuing from different parts of the boiler, and in each of these the electrometer indicated the presence of electricity. From the peculiar manner in which the steam blew off from the safety-valve when the weight on the lever was lifted, it was quite impossible to try any satisfactory experiment upon the steam which was allowed to escape by that means. I applied the gold-leaf electrometer to various parts of the boiler, which, I ought to observe, is in direct communication with the ground by means of the steam-pipes, but could scarcely detect a trace of electricity in any part of it.

The engine has another boiler besides the one in question, and the two boilers lie immediately adjacent to each other. Having been informed that similar phenomena had been discovered in this second boiler, I proceeded to apply the electrometer to some small pencils of steam which were escaping in different parts, and found the same indications which I had observed under similar circumstances in the first boiler. I then raised the safety-valve, and the column of steam which escaped from it proved as highly charged with electricity as the horizontal jet which issued from the other boiler, and in which the phenomenon had first been observed.

Upon inquiry, I found that the water used in the boilers was obtained from a neighboring colliery, where it was pumped out of the mine, and that the same water was used for the boiler of a small high-pressure engine adjoining the colliery from which the water was procured. In order, therefore, to form an opinion whether or not the phenomenon in question was dependent upon the quality of the water from which the steam was generated, I proceeded to examine the steam evolved from the boiler to which I had been referred, and which proved to be a very small one. The valve was loaded with only 20 pounds on the square inch, and I learned from the engine-man that no appearance of electricity

had ever been noticed in the steam. Upon trial, however, I succeeded in obtaining very distinct sparks of electricity from the column of steam which issued from the safety-valve. The sparks were certainly weaker than those obtained at the other engine, but this may reasonably be ascribed to the inferior pressure of the steam, and smaller size of the boiler.

I then repaired to another high-pressure engine, which belonged to the same establishment, and the boiler of which was supplied with *rain* water instead of that drawn from the mine. In this case the pressure of the steam was 40 lbs. on the square inch. The valve was inaccessible, but a powerful jet of steam was obtained from the upper guage-cock; I could not, however, obtain any trace of electricity in the steam from this boiler, not even sufficient sensibly to affect the gold-leaf electrometer. The presumption, then, is exceedingly strong, that the phenomenon is in some way occasioned by the peculiar nature of the water from which the steam is produced. I inclose you a specimen of the incrustation,* of a month's growth, deposited by the water from the mine in the boilers in which it is used.

I shall be glad to receive any further instructions from you as to the proper mode of pursuing the investigation, and should be much gratified to hear your opinion as to the cause of this most curious phenomenon.†

Experiments on the Electricity of High-Pressure Steam. By H. L. PATTINSON, *Esq. In a Letter to the Editors of the Philosophical Magazine and Journal.*

A very singular phenomenon, viz. the production of electricity by two steam-boilers, has been observed in this neighborhood within the last few weeks, the particulars of which I have the pleasure of transmitting to you for publication in your valuable journal. The boilers in question are situated at Cramlington Colliery, eight miles north-east of Newcastle, where they supply steam to a high-pressure engine of 28 horse power, employed on the waggon-way to haul full and empty waggons to the top of two inclined planes, leading to the colliery on the one hand, and to the river Tyne on the other. The boilers are cylindrical, with circular ends, each 21 feet long and 5 feet diameter. They are supplied with water from an adjacent pond by iron feed-pipes, four inches diameter, and the steam they produce is conveyed to the working cylinder by other iron pipes, six inches diameter, which pipes

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* The incrustation is gray and hard: it contains traces of a soluble muriate and sulphate, but consists almost entirely of sulphate of lime, with a little oxide of iron and insoluble clayey matter, carried in probably by the water. There is hardly a trace of carbonate of lime in it.—M. F.

† The evolution of electricity by vaporization, described by Mr. Armstrong, is most likely the same as that already known to philosophers on a much smaller scale, and about which there are as yet doubts whether it is to be referred to mere evaporation, as Harris says, or to chemical action, according to others. This point it neither settles nor illustrates; but it gives us the evolution of electricity during the conversion of water into vapor, upon an enormous scale, and therefore brings us much nearer to the electric phenomena of volcanos, water-spouts and thunder-storms than before.—M. F.

form also a direct metallic communication between the tops of the boilers. By means of appropriate valves the steam is supplied to the cylinder from one or other boiler at pleasure. A pipe, two inches diameter, leads from the bottom of one boiler on the outside of the brick-work to the ash-pit, through which the sediment deposited by the water is occasionally blown from one of Scott's patent collecting cones, and a similar pipe is attached to the other boiler. The boilers are set in brick-work in the usual way, the fires below, with flues reaching all round, and passing into the chimney also in the usual manner. The flues are covered with large flat bricks, and in the space between the boilers the two flues are necessarily separated by a brick wall. The safety-valves are attached to the boilers by flange joints; and between the flanges, to render them steam-tight, is placed a ring of plaited hemp covered with a cement of litharge, sand and linseed oil, mixed up together, and when applied of the consistence of glaziers' putty. This cement, as it soon becomes hard, is used about the engine for steam joints which occasionally fail; but all the joints of the pipes are made of iron borings and sal-ammoniac, as ordinarily employed by engine-wrights. The steam is worked at a pressure of thirty-five pounds per inch.

The joint between the top of one of the boilers and the seat of its safety-valve had given way, and steam was issuing forcibly through this aperture, when on Tuesday, September 29th last, the engine-man, William Patterson, while standing with this current of steam blowing upon his legs, took hold of the weight attached to the lever of the safety valve, to try the strength of the steam, when he felt a peculiar pricking sensation in the ends of his fingers, but as the steam prevented him from seeing distinctly, he thought he had merely struck his fingers rather suddenly against the weight. On Friday, October 2d, on taking hold of the lever, he again felt a sensation in his fingers of the same kind as before; and on Saturday, the 3d, on touching the weight, this sensation was stronger and more distinct; so much so, as to arrest his attention and lead him to mention it to some other workmen employed about the engine, who all handled the weight, and convinced themselves that there was something about it very unusual. During the time they were thus employed, Patterson applied his finger gently to the lever, and perceived a spark. This was repeated by the whole party, and they soon found that sparks could be obtained from any part of the end of the boiler, as far as the valve upon the steam-pipe connecting the two boilers, and also from the pipe through which the sediment is blown, as already described. They observed further, that while standing in the volume of steam issuing from the joint, and touching the boiler, these sparks were always much stronger than when the boiler was touched by a person not in the current of steam. In one or two cases, according to their account, when the current of steam issuing from the joint was very strong, the person exposed to it being probably partially insulated by standing upon the dry and warm brick-work surrounding the boiler, gave strong sparks to others out of the current on bringing his hands to theirs; and once or twice they felt, under these circumstances, something like a slight electrical shock. It may be observed, that at this time the weather was exceedingly fine and dry. It was not long before

the engineer of the colliery, Mr. Marshall, became acquainted with these circumstances, and his first feeling was to apprehend that the boiler was in danger of exploding, for, as he said, "when there was fire on the outside of the boiler, he did not know what there might be within." He accordingly sent to Messrs. Hawks, of Gateshead, who built the boiler, for a person to examine it, and Mr. Golightly, their manager in that department, went out on Wednesday, the 7th inst. for that purpose. He gave his opinion as to the safety of the boiler, and returned much surprised at the phenomena it presented. The singular circumstance of a steam-boiler yielding electrical sparks, and giving shocks, now began to be noised abroad; and my friend, Mr. Henry Smith, of Newcastle, who had heard the account both from Mr. Golightly and Mr. Marshall, wrote me a note acquainting me with the matter, and desiring me to go with him to see it, which I did on the 11th inst. and again on the following day, having with us the second time proper electrical apparatus. On our first visit, the boilers being unplugged and empty, we merely satisfied ourselves as to all the particulars of their setting, &c. already detailed. Next day, on our arrival, we found the engine at work, the steam up to a pressure of 35 lbs. an inch, and blowing off strongly at the joint in the boiler. The day was a little damp, but yet not unfavorable, and we were informed on alighting that the indications of electricity were very faint and weak; however, we proceeded to our examination, of which the following is the result:

1. On touching the boiler with the blunt point of a pen-knife any where about the circular end, the weight or the safety-valve itself, with the steam strongly blowing out of the joint, but with no part of the person exposed to the volume of steam, no spark could be perceived whatever.

2. On immersing one hand in the current of steam, and touching the parts of the boiler already named with the point of a pen-knife held in the other, a very minute but distinct spark was perceived, and this occurred equally on all parts of the boiler or safety-valve within reach.

3. By standing in the current of steam, so as to allow it to blow forcibly upon the person, the spark became larger: it was then one-eighth of an inch long.

4. On holding a large shovel in the current of steam with one hand, and touching the boiler with a pen-knife held in the other, a spark was obtained three-eighths of an inch long.

5. The cap of a gold-leaf electrometer, the bottom of which was held in the hand, was applied to the weight, the body of the operator being entirely out of the current of steam; and no divergence was produced whatever.

6. The electrometer held in the hand had its cap applied to the weight, the other hand of the operator being immersed in the current of steam: strong divergence was immediately produced.

From this it was evident that the electricity proceeded from the steam; but as the boiler-house was damp, so that insulation by glass could not well be preserved, a copper wire was attached to the shovel already mentioned, the end of which wire terminated in the engine-house, some yards distant from the boiler-house, where was placed a table. The shovel was held by Mr. Smith in the current of steam, with

its edge about an inch and a half from the aperture through which the steam issued, and the wire leading away from the shovel was insulated by being attached to sticks of sealing-wax held by assistants. Mr. Smith stood on an insulating stool.

7. On touching a pith-ball electrometer, the threads of which were five inches long, with the insulated wire leading from the shovel held as mentioned, the balls diverged four inches with positive electricity.

8. The wire was attached to an insulated tin conductor, when it yielded sparks half an inch in length.

9. A pointed wire attached to this conductor exhibited the brush of light a quarter of an inch long, which always attends the escape of positive electricity from a point into the air.

10. A small jar was now charged so strongly as to give a rather disagreeable shock. By this time a large crowd of men, women, and boys from the "Pit Raw," or pitmen's residences near the colliery, attracted by the novelty and singularity of the circumstances, had gathered about us, filling the engine-house and looking on with great curiosity and interest. A circle of sixteen of these men and women was formed, and they received together, much to their surprise and merriment, a powerful shock from the charged jar. This was several times repeated, the numbers receiving the shock varying each time from twelve to twenty.

11. A stout card was perforated by a discharge of the jar; and cotton wrapped round the end of a copper wire and dipped in pounded resin, readily set on fire.

12 When the edge of the shovel was made to approach the aperture through which the steam issued as near as $\frac{3}{4}$ of an inch, very vivid and bright sparks of that length passed continually between it and the boiler.

13. The second boiler did not discharge steam through any fissure, but on lifting its valve by the hand it blew off in a strong current. When the shovel was held in one hand in this current of steam issuing from the safety-valve, and the boiler was touched with a pen-knife held in the other, a spark passed exactly, as under the same circumstances in the boiler subjected to the above experiments.

From this it would appear that the steam of both boilers was in the same electrical condition.

During the whole of these experiments the engine was doing its work as usual, occasionally going and occasionally standing; but no difference was observed in the electricity given off by the steam.

I have been most careful to supply an exact account of the facts of this extraordinary, and, as far as I know, unprecedented case, but I do not offer any theory to account for the phenomena. It is hardly possible to suppose that there is any local peculiarity about these boilers, or the place where they are situated, to occasion the highly electrical condition of the steam produced in them; and yet it is as difficult to suppose the fact of high-pressure steam being electrical, a general one; for if it were so, it could hardly, up to this time, have escaped observation. The conditions, therefore, under which steam becomes electrical require to be investigated, and it is not unlikely that the investigation may lead to important results.

Bentham-Grove, Gateshead, Oct. 19, 1840.

On extinguishing Fires by Steam—Woven Hemp Hose, &c. In a letter to the London Mechanics' Magazine, by WM. BADDELEY.

At the recent meeting of the British Association, where "all have their curious somethings to disclose," Mr. Wallace advocated the employment of steam for extinguishing fires in steamboats, as narrated at page 361 of your last number.

After the extensive and complete investigation of the merits of steam as an extinguishing agent, and the result of the Lancashire experiments, recorded in your previous volumes, I must confess I was somewhat surprised at this resuscitation of the question. My present object however is to point out the fallacy of Mr. Wallace's experiments, and the erroneous nature of the inferences attempted to be established by them. In the first instance, a fire of great energy and of unusual magnitude (composed of "4½ cwt. of very combustible materials, such as tar barrels, &c.") was kindled in a small cabin, which was closed up and a jet of steam admitted. The fire goes out! Would it not have done so, even if no steam had been present? Would not a fire of such a character, confined in a limited space, holding at first but a comparatively small portion of air, and further access of air being almost entirely prevented, have stifled itself in the same time that it was found to be extinguished, as supposed, by the agency of the steam? Again, in another experiment, two grates containing unusually large fires, each of "about one cwt. of blazing coals, well kindled," were lowered into the cabin, the hatch on the deck and the cabin doors were shut, and the steam let in; in fifteen minutes the fires were found to be extinguished—as a matter of course. But a coroner's inquest seems necessary to be empanneled, to ascertain whether a verdict of *fire-slaughter* will lie against the steam—or, whether it is not (as I contend) a clear case of *fele do se*, by self suffocation!

The importance of ascertaining this point, in order to give the slightest value to the experiments, must be obvious.

It unfortunately happens, however, that the experiments of Mr. Wallace, whether they are right or wrong in *principle*, can be of little practical utility. I do not recollect a single instance of fire in a steam-boat, where any such application of steam, even if beneficial, could have been made. Fires in such vessels most commonly arise from spontaneous ignition of the coals; or from the coals, or timbers of the vessel, being placed too near the heated surfaces of the machinery, in positions altogether incapable of being enclosed for the application of the steam-bath. The accidental ignition of the cabin furniture (the only case in any way analogous to Mr. Wallace's position) is a very unusual occurrence. After the reading of Mr. Wallace's paper "it was stated" (by way of a clencher I suppose—we are not told by whom) "that in Philadelphia, and now in London, the firemen always direct the water towards the lowest part of the fire, *that it might be converted into steam.*"! Philadelphia is so far off, that I suppose "we may as well believe it as go to see." As for London, however, the statement is wholly untrue, and without a shadow of foundation; and the inference is, that the other is ditto. The firemen of London recognize the assistance of no such auxiliary as steam; the practice imputed to them was unknown, and although now made known, will continue unpractised.

Mention was also made of the woven hemp hose for the fire-engines, said to have been used in Russia more than 40 years; it might have been stated that it was used more than twice 40 years ago in England, and abandoned. Very strenuous efforts have recently been making to effect its re-employment here, but without success. Trials have been made with several lengths by the firemen, but their destruction was so rapid, and their bursting frequently so inopportune, that this material has again been consigned to well-merited oblivion. The modern process of rivetting leather hose, instead of sewing, has given to that article a superiority and fitness, both in material and manufacture, not to be surpassed.

At a fire which happened at Clapham a few months back, for more than half an hour after three fire-engines from London reached the spot, no water could be obtained from the mains of Vauxhall water works, and at my request the three engines were placed in a chain from a pond on the common, and their stock of hose was just sufficient to reach the fire; but one length, belonging to the West of England engine, was unfortunately the *woven hose*, and no sooner had the engines commenced working, and the water reached the branch-pipe, than this length of hose burst—thereby, for a short time, discomposing the well-arranged system of operation. This length was one given to the West of England in exchange for another which had previously served them a similar trick.

We have lately seen the woven hose in use at Philadelphia, and conversed with several firemen in relation to its quality: they unanimously gave it a preference to leather, when required to lead from the goose-neck to the pipe, for mounting ladders, entering buildings, &c. It is much lighter than leather, and equally capable of resisting the mere pressure of water. When laid on the ground, however, to conduct the water from one engine to another, it is very unsafe, as an engine-wheel passing over it is sure to cut the fibre so as to destroy the hose for further use; while leather, in the same circumstances, is not materially injured.—*Ed. Repertory.*

To correct a Square. In a letter to the London Mechanics' Magazine, by T. B. DARLINGTON.

Take a square plate as broad as the square to be corrected is long. Apply the square to one edge, which mark, that you may know it, and call it the first. Alter the second edge till it fills the square exactly, then apply the square to it and alter the third, which, being made correct, apply the square and make the fourth correspond unto it. Having thus made the four sides of the plate answer the square at the three corners, apply it to the fourth, when it will at once prove a true test of the correctness of the square. If on applying the square to the fourth corner, it answers without deviation to the fourth side and the first, it is an evi-

dent proof that the square is delicately true, since whatever deviation is manifested it is four times the real error of the square. This is evident, since each repeated application of the square adds its own error to the former.

Let those, then, who have tested their squares by this method, alter their squares a fourth of the deviation, shown at the fourth corner. To come to the utmost exactness, they must repeat the operation as before described, till the plate corresponds with the square at every side, and the square with the plate at every corner. It is almost needles to state, that the operation must be performed by a good workman and with the greatest exactness. If the square to be tried be large, the square plate need not be solid, but made like a frame, which, having been made delicately true by the foregoing method, might be carefully preserved, and would serve as a true test by which to regulate all squares of smaller dimensions.

I have known some persons to say that it was impossible to make a plate square, or to answer a square on every side, not considering that the deviation shown on applying the square to the fourth angle, having made it fit the other three, is owing to the incorrectness of the square itself, and not to the impossibility of performing the operation.

Some Observations on the aqueous Solution of Carbonate of Magnesia with excess of Carbonic Acid, and on the Salt which it affords by spontaneous Decomposition. *By* JOHN DAVY, *M.D., F.R.S* [Communicated by Sir David Brewster to the Philosophical Magazine.]

I have been induced to institute some experiments on the solution of carbonate of magnesia in water strongly impregnated with carbonic acid gas, in consequence of the high repute, on very questionable grounds, which it has lately acquired as a medicine.

The solution I have used is that prepared and sold by Mr. Dinneford of New Bond Street, with the designation of Dinneford's Solution of Magnesia, and with the following recommendation on the label: "The great advantages of this elegant preparation are, that being in a *fluid* state and possessing all the properties of magnesia in general use, it is not likely to form dangerous concretions in the bowels; it corrects acidity and heart-burn effectually, without injuring the coats of the stomach, as carbonates of potash and soda are known to do; it prevents the food of infants turning sour, and in all cases it acts as a pleasing aperient, particularly adapted for females."

Such a recommendation I should not have thought it right to notice, were it an ordinary quack eulogy, and unsupported by certificates given by respectable medical men; and moreover were I not assured that great faith is placed by many persons in the asserted virtues of the preparation, and that the use of it is rapidly extending.

The first trials I subjected the medicine to, were made with a view to test the permanence of the solution; as by exposure to the air in an open vessel, exposure to a temperature of 100° Fahrenheit, in a vessel loosely corked, and to the action of the air-pump under an exhausted receiver.

The result in each instance was very similar; carbonic acid gas escaped, or was expelled, and a salt was deposited in the form of minute prismatic crystals.

This separation of the magnesia in a solid form, on the disengagement of the excess of carbonic acid, was no more than might have been expected from the known nature of the compound, and the artificial manner in which it is formed by the condensation of the gaseous acid; and must be considered as quite incompatible with the declaration of its "fluid state" in the stomach and bowels, and sufficient ground to call in question the propriety of placing confidence in the preparation as a medicine, in preference to common carbonate of magnesia or calcined magnesia, than either of which it is so much more costly an article.

The prismatic salt deposited on the escape of the excess of carbonic acid, has been examined by several chemists; resting chiefly on the results of the experiments of Berzelius, and the late Dr. Henry, it has been considered as a hydrated carbonate of magnesia, composed of one proportion of magnesia, one of carbonic acid, and three of water.

From the experiments which I have made on it, it appears to be composed as follows, viz.

29.61	Magnesia.
32.22	Carbonic acid.
10.27	Water expelled at 212° Fahrenheit.
27.90	Water expelled by a higher temperature, as by ignition.
100.00	

or of one proportion and half of magnesia, and carbonic acid, one of water expelled at 212°, and three proportions of water expelled by a higher temperature. Compared with the common carbonate of magnesia, from the results which I have obtained operating on the latter, this appears to differ chiefly from the former in possessing half a proportion more of magnesia, and one proportion less of water, being composed of

41.52	Magnesia.
33.31	Carbonic acid.
17.47	Water expelled at 212°.
7.70	Water expelled at a higher temperature.
100.00	

These results accord tolerably with those of other inquirers who have examined this compound; the variation or want of perfect accordance, probably chiefly depends on the degree of dryness of the preparation examined, or on the quantity of water retained in the powder admitting of expulsion at 212°, which water being hygrometrical, at least in part, must vary with the degree of dryness of the atmosphere to which it is exposed.

The method by which these two compounds of magnesia and carbonic acid were analyzed was a simple one, admitting of considerable accuracy.

The quantity of water expelled at a temperature of 212° was determined by exposure of an hour or more to the heat of a steam-bath; the quantity of carbonic acid, by acting on the compounds, very carefully weighed, by muriatic acid, saturated with carbonic acid, over mercury in a graduated tube; and the quantities of magnesia and of water ex-

pelled at a higher temperature than 212° by the action of a red heat, continued for two or three hours, till no farther loss of weight was produced by a continuance of the high temperature. In estimating the proportion of carbonic acid, the calculation was made on the ground that 100 cubic inches of this gas weigh 47.262 grains.

A few words relative to the properties of the first-mentioned carbonate. Its tendency to crystallize is remarkable: however obtained, even when rapidly separated by the expulsion of the excess of carbonic acid by heat, it has been deposited in a crystalline form. This form is not obvious to the naked eye; but when the powder is examined by the microscope, each particle is found to be a distinct prismatic crystal. And the persistence of this form is no less remakable; it is not destroyed by decomposition; the powder after ignition, after the expulsion of the whole of the water and carbonic acid, under the microscope shows no alteration; each particle is still prismatic, and when moistened with water is transparent.

It is asserted that this carbonate readily loses the water with which it is combined. In a dry atmosphere it loses a portion of the water, which perhaps may be considered as hygrometrical, and at the same time loses its transparency; but I find, as has been already remarked, that a temperature of 212° expels only one portion, and that a high temperature is requisite to expel the three remaining proportions, and which are probably the strictly chemically combined water.

It is also said that this compound is altered by the action of cold water, and by that of boiling water; that in one instance a solution of bicarbonate of magnesia is formed, and an insoluble carbonate containing a smaller proportion of carbonic acid; and in the other, that the same insoluble subcarbonate is produced, but without the solution of bicarbonate, the proportion of carbonic acid required for this being expelled in the form of gas. The results of the trials I have made have not confirmed either of these conclusions. It has appeared to me to dissolve both in hot and in cold water, without undergoing any decomposition. I have not been able to obtain an insoluble subcarbonate of magnesia by acting on the prismatic salt by cold water, or carbonic acid gas from it by boiling water—for instance, boiling it in distilled water in a retort connected with a mercurial pneumatic apparatus. It is true, that when this carbonate is thrown into hot water, there is a disengagement of air, but the air is common air mechanically entangled, not carbonic acid gas which had been chemically combined.

Both the hot solution and the cold, on evaporation, yielded the prismatic compound. 1000 grains of water at the temperature of 60° appear capable of holding in solution about four grains; thus 326.6 grains of the solution of carbonate, after the excess of carbonic acid gas had been expelled by the air-pump, afforded on spontaneous evaporation 1.5 grain of crystaline salt.

Whether this slight degree of solubility can be useful, considering the qualities of the compound as a medicine, or whether the crystaline spicular prismatic form which it assumes on separation of the excess of carbonic acid by which the carbonate was brought into solution can be injurious to the coats of the stomach, as a mechanical irritant, it is far from easy to determine; the probability is, reasoning anologically, that

neither the one nor the other circumstance, medicinally considered, is of much consequence.

We publish the above article for the purpose of showing our readers the true qualities and properties of the *new liquid magnesia* of Sir James Murray and others, large quantities of which are daily sold in this city. It will be perceived that only *four* parts, by weight, in *one thousand* have any medicinal properties. —*Ed. Repertory.*

Proper form for Cast Iron Wheels. In a letter to the London Mechanics' Magazine, by Wm. Baddeley.

While observing the progress of the repairs lately going on in the roadway of Blackfriars-bridge, I was struck with the havoc made in the wheels of the hand-barrows, a considerable number having been broken.

The barrows were of the description commonly employed by excavators, having a cast iron wheel of six spokes.

The ill effects of casting iron wheels with the radii or spokes directly opposed to each other, is perfectly well understood and guarded against in the larger description of wheels, such as fly-wheels and the like, but in the smaller class of wheels the precaution seems to be totally disregarded. It may be argued that from the extreme shortness of the radii there is not an equal degree of contraction and tension; nor is there, but there is still enough to occasion much mischief. I believe it would be found that increased durability would result from giving the wheel one spoke less—that is, by making them with five spokes instead of six; though from the trifling addition to the cost, compared with the great increase of strength and durability, a seven spoke wheel would, I apprehend, prove the best and cheapest.

From the great number of these barrows constantly employed by various contractors in different parts of the country, I think this hint may be worth attention, as tending somewhat to abridge "the wear and tear" of this portion of the machinery.

MISCELLANEOUS.

Theatrical Machinery.—A patent has recently been obtained for an improved method of adjusting and working theatrical scenery and apparatus. The object proposed by the patentee is the greater speed and facility with which stage scenery may be brought forward, shifted, or removed. The arrangement about to be described provides means for shifting or removing simultaneously, and without noise, 35 distinct pieces of scenery, viz. ten side-scenes removed, and ten fresh subjects brought forward; five sets of clouds removed and five substituted, and five main scenes removed. The general arrangement of the machinery for effecting the above may be described as follows: The interior of

the house between the basement and the roof may be said to be divided into four floors or compartments, viz.—1. A raised platform, on which the gearing for working the stage traps is to be placed.—2. The stage, with traps of various forms and dimensions, including a considerable portion formed to rise or fall by suitable machinery, and called the sinking stage.—3. The lower flats, between which and the stage are placed the wing scenes: between the framing formed by the girders and the supporting columns, and stretching from side to side of the stage, are suspended the border frames, which can be raised or lowered by means of ropes passing over drums, and connected with counterpoise weights.—4. The upper flats upon which the inventor places the moving power, to communicate motion to the whole.—On each side of the stage on the upper flat, are placed a series of frames called main scene carriages, having racks, which can be connected with pinions or long horizontal shafts, when required to be moved backwards or forwards: these two shafts are connected at their extremities by a third shaft. From the upper horizontal shafts, by means of bevel gear and vertical rods, on the lower ends of which are drums, an endless chain is driven horizontally in either direction, to which are attached the borders representing clouds, foliage, arches, &c. The side frames, of which the number is limited by the depth of the stage, may be either flat, circular, or triangular: in the present case they are triangular, and receive a forward, backward, or rotary motion, or both at pleasure, and can be placed at any convenient angle to the audience, so as to represent closed doors, &c.: at every change of the scene they will be moved round 120 degrees, or one-third of a circle: the whole of the side frames may be moved together or separately, by means of gear connected with the moving power on the upper flat. Attached to the centre of the border frames, and revolving on a pivot, are the traversing frames for crossing the stage in any direction, and at any given inclination: these, when ready for use, are raised up and secured at one end so as to form an inclined plane, and the object to be traversed having been attached to a wire passing round a drum fixed in a heavy frame, will descend by its own gravity. The trap-frame consists of a rectangular platform traversing on the lower or fixed platform, and having an upright frame of iron mounted on rollers, and capable of being traversed on the lower platform in any direction: when brought under the aperture in the stage, it allows the trap to be sunk steadily by bearing on a disc or square iron plate, counterbalanced by weights. The claim is to the improved mode of shifting and working scenes and theatrical machinery, and to the obvious modifications of which the above arrangements are susceptible.

Inventor's Advocate.

Hint for House Decorators.—The walls had a novelty of decoration not peculiar to Affghanistan, as I have seen it in India, though never so well done as in the rooms I speak of; the chunam or plaster being stamped when moist or plastic, and worked into a pattern, over which a varnish of powdered talc is spread, which more nearly resembles the richness and hue of new and unused frosted silver plate than anything I have seen elsewhere. This might be introduced in London as a very cheap and elegant drawing-room decoration.

Dr. Kennedy.

Mail Steam-Packets between France and America.—The French government have ordered that—

1. A line of steam-packets shall be established, to convey the mails between the ports of Havre and New-York, in furtherance of which the Minister of Finance is authorized to treat, within the space of three months, with a commercial company who will undertake the service, on condition that they receive in payment an annual fee not exceeding 880f. per horse power. The number of steam-packets to be employed in the service of this line shall be three at the least, or five at the most; each packet to be propelled by engines of 450 horse power. A list of conditions, to be drawn out by the administration, will determine the times of departure, the number of passengers, and every detail relative to the service of this line.

2. Two principal lines of communication shall be established by the government, in order to convey the mails between France and America, and served by steam-packets of 450 horse power: one starting from Bordeaux every 20 days, and from Marseilles every month, in order to arrive at Martinique, and continuing by Guadaloupe, St. Thomas's, Porto Rico, Cape Hayti, and St. Jago, to Havana; the other starting from St. Nazaire every month, to Rio Janeiro, passing by Lisbon, Goree, Pernambuco, and Bahia. Three secondary lines, served by steamers of 220 horse power, will be established, in order to continue the principal lines: the first to Mexico, touching at Vera Cruz, Tampico, Galveston, and New Orleans; the second to Central America, touching at Chagres, Carthagena, Santa Martha, and La Guayra; the third to Montevideo and Buenos Ayres.

The Pyramid.—The pyramid is nature's own form: her mountains, the grandest of earthly masses, diminish to heaven; architectural science requires that a building, to endure, should end in a pointed summit: a mere heap of sand will by its own gravity assume a pyramidal form, and so endure for thousands of years, and long outlive a wall of granite reared perpendicularly. Bartholomew.

Consumption of Smoke.—The fact that smoke, passing over a bright fire, is consumed, has long been known; but recently a patent has been taken out for effecting the passage in the following manner:

The fire-place is divided lengthwise, by a thin wall of fire bricks, so that there is, as it were, two fire-places under the boiler, each of which communicates with the main flue or chimney by a separate flue; therefore the two fire-places would have no connection, were it not that an aperture is left at the top of the partition wall, near the front of the fire-places, by which means the two fires can communicate with each other, so that were the flue at the end of one fire closed, and the other open, the only passage for the hot air and smoke of the fire, whose direct communication with the chimney is cut off, would be through the aperture at the top of the partition wall, and over the other fire whose direct communication with the chimney is still open. It will be seen that by means of this arrangement the principle is easily applied. The fire, whose direct communication with the chimney is closed, being charged with fresh fuel, its smoke, in its route to the chimney, must pass through

the aperture of the partition and over the other fire, which, being bright, effectually consumes it. By the time the fire last charged has burnt bright, the other will require replenishing; its communication with the chimney is therefore closed and the other opened, the low fire is charged, its smoke passes over, and is consumed by the other bright fire. Thus by alternately charging one fire and then the other, all the smoke is consumed. The machinery for alternately closing the dampers is exceedingly simple. The smoke being all consumed, a saving of fuel is obtained. Civil Eng. and Arch. Jour.

The Royal George.—By far the most magnificent exhibition which has yet been witnessed of the enormous force of gunpowder, when exploded under water, took place at Spithead the 5th ult. The charge, which consisted of 25 barrels, or 2250 lbs. was placed at the depth of 11½ fathoms, or about 70 feet from the surface of the water, nearly over the original position of the fore hatchway of the old ship. When Col. Pasley's trumpet sounded, and the word was given to "Fire," the whole area was shaken as if by an earthquake, the surface became ruffled like the top of a glacier, and, in the next instance, literally in less than two seconds, the water bulged up and rose to the height of about 20 feet, after which a sort of second burst occurred, which projected the sea in huge masses high into the air. Such was the violence of this effort that the spray was thrown completely over all the adjacent vessels in a drenching shower, accompanied by gusts of wind. The columns of water ascended to the height of from 50 to 100 feet, and the commotion in the water, with the quantity of mud, the number of dead fish, and other symptoms of violence, which spread in every direction, far exceeded the effects of any other explosion of a similar nature. Ib.

Tanning.—A discovery has been made which seems likely to revolutionize the trade. By means of a tanning machine or pair of horizontal rollers fixed over a tan-pit, between which is introduced a belt or band of hides attached by ligatures to each other, to the number of 50 to 100, and by which the rollers are constantly fed or supplied, the hides are lifted out of the pit on one side of the machine; and as they pass between the rollers, the exhausted ooze or tanning liquor is pressed out of them, and they are deposited in folds in the pit, on the other side of the machine, where they absorb another supply of fresh ooze. The first hide having been inserted between the rollers, the others follow in succession, and upon arriving at the end of the band the motion of the roller is reversed, and the belt is returned through the machine to receive another squeeze. This alternating motion is constantly repeated, the pit being replenished from time to time with fresh solutions of tan, till the operation is completed. The effects produced by this simple plan, as we have satisfied ourselves by the inspection of documents from those who have been working on the patent method for many months, and from those who have purchased, manufactured and worn the leather, are:—1. The shortening the time of tanning to one-fourth of that generally required.—2. The production of a considerable increase of weight. 3. The leather tanned by this method resists water longer than that tanned by the old process.—4. The new method is cheaper to work

than the old.—5. That it is applicable to the existing tan-yards, at a comparatively trifling expense, with a capability of working in rounds or series, and of expending tan and liquor.—6. That it is available for all sorts of leather. Bristol paper.

Turning-Lathes.—At the ordinary meeting of the Society of Arts on Wednesday, the large silver medal was awarded to Mr. J. Hick, jun. of Bolton, for an improved expanding mandrel for turning-lathes. It is necessary that a mandrel should fit so accurately as to bite on the inner surface with a force sufficient to counteract that of the tool, and, in the ordinary mode, the same mandrel cannot be used for two pieces which are of different diameters. Consequently, in many engineering establishments, a stock of mandrels is kept, amounting to 600 or 700. Mr. Hick purposes to do the same work with eight sizes of the mandrel, from one inch and a quarter to ten inches. He effects his object by having the spindle of the mandrel shaped on the frustrum of a cone, on the face of which are four dove-tailed grooves to receive wedges, the under faces of which have the reverse inclination of the cone, so that the lines of their outside faces are always parallel with the axis of the mandrel. A nut is screwed on the spindle, which acts on the wedges through the medium of a conical cup, which drives them up to their bearings inside of the work. London Surveyor, &c.

New Form of Chimney.—I have often been surprised how the use of chimney pots got introduced into this or any other country. I consider them perfectly useless articles. Perhaps if I draw the attention of your readers to the form of the tin horn that is used by the guards of the mail coaches, the principle of chimneys will be better understood, and if builders will only try the experiment they will be fully convinced. If the large end of the horn be placed downward over some ignited bituminous matter, we shall find only part of the smoke will ascend, but if we place the small end down, we shall not only find the draft greatly increased, but the smoke will ascend freely up the tube. Ib.

New Engine of War.—M. Billot has invented a machine which discharges 2000 balls, of half a pound each, every minute, or 120,000 per hour, without cessation. Its action may be continued or arrested at the will of the party in charge of it. The discharge takes place at four different points, and may be directed at as many objects, or united against one. The machine weighs about 85 lbs. and its range is about 3280 feet; but, if one were constructed of about $1\frac{1}{2}$ cwt., its range would be quadrupled. The use of the machine does not depend upon gunpowder, air, or steam, as a moving power. Ib.

Animal Heat.—Dutrochet has found that the temperature of the frog in the open air is 1° C. lower than that of the atmosphere, but that when immersed in water, its temperature is ·03 to ·05 C. higher than the surrounding air. The temperature of the gray lizard was ·18° lower than that of the atmosphere; that of the carp when in water is the same as that of the liquid. The leech and snail are colder than the atmosphere. Athenæum.

Large Specula.—A paper upon the reflecting telescope, read by Lord Oxmantown, F. R. S., before the Royal Society, at a meeting in June last, enters minutely into the details of some experiments made with that instrument, of the precautions requisite to insure success, and of the manipulations ultimately adopted in forming a speculum three feet in diameter, subsequently applied to a telescope, mounted in a manner very similar to that of Sir John Herschel. The author states, as the results he arrived at, that specula can be made to act effectively, when cast of the finest speculum metal, in separate portions, and retained in their positions by an alloy of zinc and copper, as easily wrought as common brass, and that they can be executed in this manner of any required size; that castings of the finest speculum metal can be executed of large dimensions, perfect, and not very liable to break; that machinery can be employed with the greatest advantage in grinding and polishing specula; that to obtain the finest polish, it is not necessary that the speculum should become warm, and that any temperature may be fixed upon, and preserved uniform during the whole process; and that large specula can be polished as accurately as small ones, and be supported so as to be secured from flexure. Phil. Mag.

Firing Blasts under Water.—It occurs to me that a much more simple, and much more efficient method for firing blasts under water, may be obtained than the method used to break up the Royal George; and a method so simple that it would not require a colonel to superintend. A percussion cap is all that is necessary to fire 10,000 lbs. of powder as easily as an ounce. Suppose that an air-tight compartment at the top of the powder cylinder, to be fitted up with an apparatus similar to the lock of a gun, and a strong spring carrying four or five hammers, to strike as many caps. The cock to set the spring being ground into the side of the box, and fitted with a leather collar; the trigger should also pass into the box in a similar manner. What would be more easily for the diver, after having secured the cylinder strongly to its place, than to raise the spring and fasten a strong line to the trigger? The line might be of any length, and when strongly pulled would as effectually fire the blast as a dozen batteries. The caps, being inside the air-tight box, would be protected from the water and kept dry.
Cor. Civil Eng. and Arch. Jour.

Chesterman's Self-Regulating Stove.—The principal novelty in this stove is the mode adopted for regulating the rate of combustion, and consequently the temperature of an apartment, by means of the vaporization of water. Within the stove, and upon the fire-chamber, which is covered, is placed a vessel of water, having in it an inverted cup like a gasometer. To the top of this latter is a lever and vertical rod, that, as the cup is raised or depressed from the action of the steam, shut or open a valve communicating with the ash-pit. There are, of course, minor arrangements for suffering the surplus steam to escape, re-supplying the water-box, &c. Abridged from Lond. Mech. Mag.

Preserving Size.—A correspondent of the Lon. Mechanics' Magazine says that size may be kept from fermenting, or even recovered when partially decomposed, by adding to it a solution of soap.

Wool.—In 1812, the first sample of German wool, weighing 28 lbs. was sent over to England on trial, and the quality was so much approved of, that in two years afterwards our shipments from the same quarter equaled 3,432,456 lbs. and in 1825 rose to the astonishing quantity of 28,799,661 lbs. Since that period there has been a slight decrease, the importation of 1839 not having exceeded 23,837,805 lbs. But so perfect have the Germans become in the management of sheep, and the preparation of their fleeces, that in our market their wool is now held in much higher estimation, more particularly that of Saxony, than the Merinos of Spain ever were. The wool is better adapted to felting purposes, yielding cloth remarkable for its fineness of texture. This surprising increase in the quantity of sheep, and improvement in fleeces, have been obtained in Germany, notwithstanding the flocks during six months of the year are fed artificially, and, to avoid the rigors of a severe climate, subjected to much confinement. Polytechnic Jour.

Optical Illusion.—It has been stated that certain flowers, towards evening in summer, corruscate, become phosphorescent, or emit a momentary light. Some persons have described their observation of this minutely. I had often endeavored to witness it myself, and had even resorted to artificial contrivance to produce it.

On the 19th of June, 1799, late in the evening, when the twilight was deepening into a clear night, as I was walking up and down the garden with a friend, we very distinctly observed a flame-like appearance near the oriental poppy, the flowers of which are remarkable for their powerful red color. We approached the place, and looked attentively at the flowers, but could perceive nothing further, till at last, by passing and repassing repeatedly, while we looked sideways on them, we succeeded in renewing the appearance as often as we pleased. It proved to be a physiological phenomenon, such as others we have described, and the apparent corruscation was nothing but the spectrum of the flower in the compensatory *blue-green* color.

In looking directly at a flower, the image is not produced, but it appears immediately as the direction of the eye is altered. Again, by looking sideways on the object, a double image is seen for a moment, for the spectrum then appears near and on the real object.

The twilight accounts for the eye being in a perfect state of repose, and thus very susceptible, and the color of the poppy is sufficiently powerful in the summer twilight of the longest days to act with full effect, and produce a compensatory image. I have no doubt these appearances might be reduced to experiment, and the same effect produced by pieces of colored paper. Those who wish to take the most effectual means for observing the appearance in nature—suppose in a garden—should fix the eyes on the bright flowers selected for the purpose, and immediately after look on the gravel path. This will be seen studded with spots of the opposite color. The experiment is practicable on a cloudy day, and even in the brightest sunshine, for the sunlight, by enhancing the brilliancy of the flower, renders it fit to produce the compensatory color sufficiently distinct to be perceptible even in a bright light. Thus peonies produce beautiful green, marigolds vivid blue spectra. Goethe.

Raffaelle's Cartoons.—The cartoons were executed by Raffaelle in the years 1515 and 1516, with the assistance, says Vasari, of Francesco Penni and Giovanni da Udine. When perfected they were sent to Arras, for the purpose of being wrought in colored wools, silk, and gold thread, which being executed, the tapestries were called in Rome Arassi, or *panni di rassia.* For these works Raffaelle received 434 golden ducats, but the value of the tapestries themselves has been variously stated; even in the time of Vasari they were valued at 70,000 scudi. Rome has been twice deprived of them, but by a powerful fatality they yet cling to the Holy See. When Rome, in 1527, was plundered by the troops of Charles V, they were removed as a portion of the booty, and they became the property of Anne de Montmorency, but by what means it is not known. They were, however, in the year 1553, restored to Julius III, as a portion of Papal property. They were a second time removed from Rome, with the second series of tapestries, in the year 1798, and fell, it is said, into the hands of Jews, who proposed to burn them for the sake of the gold with which they were enriched. One was subjected to this trial, but as it did not yield the expected harvest, the others were sold at Genoa, and in the year 1808 they were again in the possession of the Roman government.

The cartoons were not removed from Arras after the execution of the series of tapestries, but whether they were left from negligence, or with the intention of working a second series, does not appear. In the year 1521, it is believed, that one of the cartoons was in the possession of Cardinal Grimani, of Venice; this was 'The Conversion of St. Paul;' and if so, it is not improbable that even thus early the original series of ten was reduced to seven; for it is well known that Rubens found only this number, and they were by him, on the occasion of his visit to England in 1630, recommended to Charles I, who purchased them, and placed them in Whitehall. On the death of Charles, the whole of his pictures were sold, and the cartoons were purchased by the republican government. After the Restoration, that model of a king, Charles II, negotiated the sale of these works with an emissary of Louis XIV; but by the firmness and persuasion of Lord Danby, the sale was set aside; therefore to this nobleman is England indebted for the possession of the cartoons, which unquestionably take their rank among the most wonderful works of their author. They were at this time in the state in which they were left by the tapestry-workers, by whom they had been divided into strips for convenience in working, having the outlines still traced with the needle; and Van der Doort, the intendant of the collections of Charles I, states in his catalogue, that five of the cartoons were sent to Mortlake for the purpose of being again copied in tapestry by Cleyn, who was the director of a *fabrique* at that place. From a passage in a MS. catalogue in the Ashmolean Museum at Oxford, we learn that the cartoons were some time kept in boxes; the passage runs thus:—"Item: In a slit box-wooden case some two cartoons of Raphael Urbinus for hangings to be made by; and the other five are, by the King's appointment, delivered to M. Francis Cleyn, at Mortlake, to make hangings by."

William III commissioned William Cooke to mount and repair the cartoons, after which they were removed to Hampton Court, where

they were hung in a part of the palace built by Sir Christopher Wren expressly for their reception; and it would have been well had this been their last removal, for it cannot be denied that they must have suffered materially from their frequent change of location. They were in 1764, transported to Buckingham House, and thence, in 1787, to Windsor, from which place they were afterwards removed to Frogmore, whence they were again sent to Windsor, where they underwent various removals from room to room. In 1814 they were again sent to Hampton Court, where they have generally since remained. The three cartoons wanting to make up the original set of ten, are 'The Stoning of St. Stephen,' 'The Conversion of St. Paul,' and 'St. Paul in Prison.'

Polytechnic Journal.

Ancient Architecture.—The points of greatest interest in Nicæa are the relics of its earliest age: little of that date now remains standing in its original form; but the grandeur and peculiar beauty of the arts among the earlier Greeks cannot be concealed even in the broken materials. Three square towers and their connecting walls are evidently built out of the ruins of one magnificent temple, which probably stood on or near their site. The stones, which are of white marble, are so well squared, that, although put together (probably by the Romans) without cement, the joints are generally too close to admit the blade of a knife between them. * * * * The cornices are of wreaths of acanthus leaves, with bold dentals, and the usual Corinthian ornaments; but our idea of the whole building can only be formed from the grand scale of the blocks, and the highly-finished workmanship of the detached fragments. Other parts of the walls are composed of the relics of apparently an earlier age—immense stones cut to fit into each other, without the attention which was paid in later ages to the horizontal courses; these would rank as Cyclopean. Again, some parts of the walls are entirely Roman, being of brick, and with arches built in the most substantial style; while others are formed of marbles of a much less pure age, in which the cross (always found among the ornaments) and the unproportioned figures and letters in the inscriptions, give them the date of the earlier Christians.

Fellows's Excursion in Asia Minor.

Nights in Madeira.—The nights in Madeira are of surpassing beauty. The moon displays a radiance, to the brilliancy of which any approach is seldom made in this country. Venus, too, shines with beautiful refulgence, casting a shadow from objects. The lunar rainbow, a meteor never or rarely seen in our country, is said to be there of frequent occurrence, which indicates a remarkable clearness of the atmosphere. Twice during last winter, I observed the appearance. On one of the nights in the month of March it was visible, on mist or clouds, on the mountains for two or three hours, in distinct and beautiful display, while the full moon was not far above the horizon. The brilliancy of the heavens, the serenity of the air, the genial mildness of the atmosphere, render the nights, especially "when the moon with more pleasing light shadowy sets off the face of things," more inviting even than the day to be abroad in. The absence of chillness and damp here permits one with safety to enjoy this, "the pleasant time, the cool," but not "the

silent;" for many of the natives, indolent during the day, then delight in their gardens and terraces; and the air is filled with the music of the guitar, and a sweet little instrument peculiar to the island, the machettinho. The air is then, too, redolent with the sweet aroma of the citron and orange groves; and heliotropes, daturæ, jessamines, roses, with many a "flowery odor" besides, unite their tribute to increase the delicious fragrance of the atmosphere. Dr. Macaulay on the Climate &c. of Madeira

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Preservation of Animal and Vegetable Substances.—The attention of the Zoölogical and Botanical Committee has been directed to the preservative properties of certain materials when applied separately, either in saturated solutions, or in different degrees of concentration. The experiments have been conducted in glass jars 6 inches by 1½; and saturated solutions of the substances employed having been prepared, were diluted with an equal, and double, quantity of water: 178 preparations of animal and vegetable substances were tried.

1. Results obtained with animal substances. Three salts of potassa—the subcarbonate, the bicarbonate, and the arseniate—have afforded the most satisfactory results. The solution of the bicarbonate afforded a flocculent precipitate: the solution half saturated appeared the best adapted. The substances preserving next best are, sulphate of zinc, muriate of magnesia, and arsenious acid. After these may be mentioned sulphate of magnesia, sulphates of potassa and of alumina (common alum) muriate of ammonia, sulphate of potash. Corrosive sublimate is a perfect preservative of animal substances; but this salt renders the substances so very hard, that singly it is unsuited to the purposes of natural history: added in small proportions to other solutions, which render objects too soft, it will probably be found of essential service, as well also in preventing the formation of flocculent matter. One part of naphtha to seven of water produces a favorable result; but when used stronger, the specimens are rendered tough. Acetic and oxalic acids decomposed the skin and cellular membrane of fish, but left the muscles untouched. A few drops of kreosote added to water, preserves the objects, but they become stained dark brown. The following substances are entirely unfit for preservatives: carbonate of ammonia, chloride of potash, muriate of barytes, muriate of lime, nitrate of ammonia, nitrate of strontian, the nitrates of barytes, soda, ammonia, and magnesia, phosphate of soda, the sulphates of soda, potash, iron, copper, and rough pyroligneous acid.

2. Results obtained with vegetable substances. The success here is very slight. None of the salts seem favorable, with the exception perhaps of the subcarbonate and bicarbonate of potash. In naphtha and acetic acid the specimens are preserved; but in the latter they lose their color, and assume a reddish tinge. Prof. Henslow observed, that although carbonate of soda of the shops is not mentioned in the report, he finds it to possess considerable preserving powers on animal substances. Dr. Balfour observed, that he had seen fruits and other parts of vegetables preserved well in a solution of common salt in water. Arsenite of potassa also preserved the color of flowers well. As a general rule he believed that saits containing oxygen would not preserve animal substances. The Rev. Mr. Brodie thought that the discoloration

of some plants might arise from the presence of tannin or other principles that acted on the substances in which they were preserved. He had observed oak and elm to become black in the same solutions in which fir and other wood became whiter than ordinary. Dr. Fleming observed, it was passing from the dead to the living, but he saw there Sir John Dalyell, who was celebrated for preserving alive the lower forms of animals, and perhaps he would give them some account of his experiments. Sir John Dalyell stated that he had in his possession an actinia, which he had kept alive twelve years, another eight years, a holothuria two years, and other animals of the same class, of varying ages. He found it necessary to change their water every four or five days: when kept longer they become weak and incapable of sustaining themselves with their suckers. The actinia will live a long time without food. They feed on small fish, crustacea, and conchifera. The food of the holothuria he was not certain about. A young skait he kept would eat nothing but whiting. Dr. G. Walker Arnott thought the preservation of plants had not been sufficiently attended to by the Committee. Spirits, he believed, a tolerably good preservative of plants. Sea-water spoiled delicate plants. The lower forms, as the fungi, &c. were most important, and nothing had been hitherto devised to preserve these in a good state. He had heard of their being kept by immersion in tallow, but had not tried it. Proceedings of Glasgow meeting of British Association.

Bleaching Vegetable Wax.—Mr. E. Solly recommends the following method: The wax is to be melted; a small quantity of sulphuric acid is then to be poured in, composed of one part of oil of vitriol to two of water, and last a few crystals of nitrate of soda are to be stirred in: the whole is to be then agitated with a wooden stirrer and kept heated. Nitric acid is thus evolved in considerable quantity and purity from a large surface, and in such a manner that all the acid evolved must necessarily pass through the melted wax. This method answers the purpose very completely, the process is cheap and rapid, and the residuum, being merely a little solution of sulphate of soda, is easily removed. When it is desired to employ chlorine in place of nitric acid as the bleaching agent, the same process may be adopted. Ib.

Cornish Engines.—A deputation from the Dutch Government having visited Cornwall, in order to ascertain by actual inspection whether the duty performed by the steam-engines employed in the mines is equal to what is stated in the monthly reports, the adventurers and agents of the undermentioned mines kindly permitted an experiment of six hours to be made on their several machines, and the duty as stated below was the result: Wheal Vor, Borlase's engine, 80 inches single, 8 ft. stroke, 123,300,593 lbs. lifted one foot; Fowey Consols, Austen's engine, 80 inches single, 9 feet stroke, 122,731,706 lbs. lifted one foot; Wheal Darlington engine, 80 inches single, 8 feet stroke, 78,257,765 lbs. lifted one foot; Charlestown United Mines, 50 inches single, 7 feet 5 inches stroke, 55,912,392 lbs. lifted one foot; Charlestown United Mines, stamping engine, 32 inches single, lifting 66 stamps, 60,525,000 lbs. lifted one foot; Wheal Vor stamping engine, 36 inches double, lifting 72 stamps, 50,085,000 lbs. The number of pumping engines reported

this month is 55. They have consumed 3730 tons of coal, and lifted 36,000,000 tuns of water 10 fathoms high. The average duty of the whole is therefore 54,500,000 lbs. lifted one foot high by the consumption of a bushel of coal. Lean's Reporter.

NATIONAL GALLERY OF AMERICAN MANUFACTURES.

We ask for the following circular from the Patent Office, the earnest attention of inventors, manufacturers, and agriculturists. It has for its object the formation of a museum that will prove both an honor and a profit to the nation.

PATENT OFFICE, Nov. 20, 1840.

Notice is given that the hall in the new *Patent Office* for the exhibition of manufactures is now completed. The hall is spacious, being 273 feet long, 63 feet wide, 30 feet high, and *fire-proof*.

Agents whose names are annexed will receive and forward, free of expense, articles which may be deposited with them. These articles will be classified and arranged for exhibition, and the name and address of the manufacturer (with the prices when desired) will be carefully affixed. Few, it is presumed, will neglect to improve the opportunity now presented of contributing their choicest specimens to the *National Gallery of American Manufactures*, where thousands who visit the seat of government will witness with pleasure the progress of the arts in these United States.

If fairs in limited sections of our country have excited interest, what must be the attractions of a national exhibition, enriched by daily additions!

The agriculturist may be gratified to learn, that commodious rooms are provided for the exhibition of agricultural implements, and also for the reception of seeds for exhibition or distribution.

The Commissioner of Patents being authorized to collect agricultural statistics, avails himself of this opportunity to solicit information of the condition and character of the crops in the several sections of the country. These data will aid him in presenting with his annual report the aggregate amount of products of the soil, and it is hoped that the public may be guarded in some measure from the evils of monopoly, by showing how the scarcity in one portion of the land may be supplied from the surplus in another.

Names of Agents who will receive and forward Packages for the Patent Office.—Collectors of the Customs at Portsmouth, N. H., Portland, Me., Burlington, Vt., Providence, R. I., Philadelphia, Baltimore, Richmond, Charleston, Savannah, New Orleans, Detroit, Buffalo, and Cleveland; Surveyors of the Customs—Hartford, Ct., St. Louis, Pittsburg, Cincinnati, Louisville; R. H. Eddy, Boston, Mass.; David Gardiner, (Custom House) New-York.

HENRY L. ELLSWORTH,
Commissioner of Patents.

DESCRIPTION OF AMERICAN PATENTS

Granted from Oct. 16th to Nov. 10th, 1840.

Improvement in Cooking Stoves. By SAMUEL L. CHASE, Woodstock, Vt. Sept. 25th. [This claim was omitted from the previous list, for the purpose of correcting an error contained in it.]

CLAIM.—I now proceed to state what I do claim, and desire to secure by letters patent, viz :—1. The manner in which I have combined and arranged the flues, including the rarefier, as set forth; that is to say, the admitting the heated air from the fire-chamber into the flue between the upper and the lower ovens, conducting it thence through the flue above the upper oven, thence down through the flue at one end to the flue under the lower oven, thence into the rarefying flue under the fire-chamber, and thence into the exit pipe—all substantially as herein made known and represented.—2. I claim, in combination, the arrangement of the respective parts of the hearth for broiling and other cooking operations; which arrangement consists of the sunk hearth, furnished with the bars *b*, *b*, the openings *c*, *c*, for the admission of air, the swinging hearth, and the flue formed by the notch in said hearth, and the sloping projection at the lower edge of the furnace door, or on the swinging hearth.

Improvement in Crosing and Chiming Staves. By CHAS. F. BERVERLY, Salem, Columbiana co. Ohio. Oct. 16th.

CLAIM.—What I claim as my invention and improvement, is the construction of the knives FF, as before described, for cutting the crose and chime, in combination with the depressions and bevels in the plate I, corresponding with the said knives FF, all as before described.

Improvement in the mode of supplying Water to Buildings for the purpose of extinguishing Fires. By ISAAC LOWELL, Niagara, N.Y. Oct. 16th.

CLAIM.—The inventor claims as new and his invention, the application of the forcing pump, on a double principle, to the purpose of raising water, and the whole of the other apparatus above described, and the right of applying and using the same to preventing, checking, or extinguishing fires consuming buildings; all which I desire to be secured to me by letters patent.

Improvement in Planting Machines. By MARTIN NICHOLS, Clearfield, Pa. Oct. 16th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the manner in which I have arranged the plough-beam, by combining it with the bed or frame of the machine by means of a bolt at one extremity of the beam, and a sword piece at the other, working through a slot in the frame, so as to allow of the plough being raised or lowered, as set forth. I also claim, in combination with the above arrangement, the windlass 10, lever 8, and bent lever 7, having at its lower extremity a friction wheel 20, as herein shown, the windlass being connected with the plough-beam 4, and lever 8, by means of cords, which, when the lever is operated, raises the front of the plough-beam, and, necessarily, the ploughs, from the earth, and at the same time

depresses the end of the lever 8, which forces down the bent lever 7, and the friction wheel 20, it carries upon the ground, so as to allow of the machine resting upon it.

I also claim the combination of the stamping machine or frame, as herein constructed, and operated with the ploughs and their coverers, as arranged on each side of the machine, the stamps *f*, on the frame being placed in the rear of the coverers, for the purpose of stamping the hills after the grain has been covered, as above described.

Lastly, I claim the manner in which I arrange and operate the brush or striker *h*, for the clearing off the cups, as herein set forth.

Improvement in Reäction Water-Wheels. By ARCHIBALD BRYCE, Campbelltown, N. Y. Oct. 16th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the combination of the inclined plane and triangular issue with the curved segment side, as herein set forth, by means of which arrangement the water is thrown to and discharged at the periphery of the wheel, instead of discharging the whole distance from the centre to the periphery as heretofore, and also the triangular issues in the bottom, combined with the rectangular issues in the circumference of the wheel, as set forth.

Improvement in the mode of hauling off Stranded Vessels. By THOMAS BELL, Bellport, N. Y. Oct. 22d.

CLAIM.—What I do claim as original, is the general manner in which I have arranged and combined the respective parts of the apparatus employed by me, so as to produce a new and useful effect, by means substantially new; that is to say, I claim as of my invention the manner of arranging the studding-booms, lifts, bobstays, guys, tackles, bullseye, and fall, so as to constitute a combined apparatus substantially the same with that herein described, for the purpose of raising the heavy anchors from the deck, clearing them of the vessel, and dropping them where required, in the manner set forth.

I claim the manner of arranging and combining the large anchors, chains, and buoys, and of connecting them with the stranded vessel, by means of the single blocks attached to the buoys and to the vessel, with the chain or rope rove through said blocks, so as to be acted upon by the windlass of the vessel, the whole operating substantially in the manner and for the purpose set forth.

I claim, in combination with the foregoing, the manner of employing the air-tight bags attached to a vessel on a beach, for the purpose of aiding in giving her buoyancy, when being hauled off by the purchase herein described.

Improvement in the method of shifting Switches on Railroads. By RICHARD W. SHECKELLS, Baltimore, Md. Oct. 22d.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is not the principle of shifting the switch by means of a projection from the car acting against a lever connected with the switch, as this has long since been done; but what I do claim is the method

of connecting the switches with two sets of leaves, one set on each side of the track; or one lever on each side of the track, in combination with the keys on the beam, in the manner and for the purpose described; and also I claim the mode herein described of locking the switches, by means of the apparatus represented in Fig. 2 of the drawings.

Improvement in the manner of constructing Machines for knitting Stockings. By BENJ. HUTCHINSON, Springfield, Mass. Oct. 22d.

CLAIM.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the employment of an endless chain of hooks, or turning needles, upon which the loops or stitches are to be received; which chain is so constructed as that it may be lengthened or shortened at pleasure, for the purpose of widening or narrowing in the process of knitting. The hooks or turning needles used by me are grooved on their upper surfaces, and are otherwise constructed in a manner similar to those used in the machines where the stockings are knit open: I do not therefore make any claim to these, or to the apparatus by which the yarn is lifted, tramped, or otherwise operated upon, but confine my claim to the endless chain, constructed and operating in the manner and for the purpose herein set forth.

Improvement in the Alarm to protect Houses against Thieves, &c. By LESTER E. DENISON, Saybrook, Ct. Oct. 22d.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the before described combination and arrangement of the oblique plate or ledge on the bottom of the money drawer with the vertical lever, horizontal plate, rods, elbow and segment plate, for springing an alarm when the money is moved.

Improvement in the Machine for hewing Plough-beams, Carriage-shafts, Cross-bars, and other Timbers. By ELBRIDGE G. MATTHEWS, Worcester, Mass. Oct. 22d.

CLAIM.—Now, what I claim as my invention, for which I ask letters patent, is the arrangement above described, by which a timber to be hewed is presented to, and guided along before the cutters, in such manner as that the cutters act upon and hew the side of the timber according to a board or edge pattern, in conformity with any desirable curve or curves given to the edge of the pattern, as above described, or in any manner analogous thereto.

Machine for planing and forming Ivory and other Comb Plates. By Julius Pratt, Fenner Bush, Aaron Pratt, Zina K. Murdock, George Reid, Alpheus Starkey, George Spencer, and John C. Rodgers, assignees of WILLIAM M. FOWLER, North Branford, New Haven co. Ct. Oct. 28th.

CLAIM.—I do not claim as my invention a circular cutter, with teeth on the inner edge of the circle merely, nor do I claim merely the mode of feeding by rollers; but I do claim as my invention the application of a circular cutter, having a diameter calculated to give the proper curve for planing and fashioning comb-plates, in combination with the

mode of feeding or bringing plates to the operation of the cutter—substantially in the manner as above specified.

Improvements in the Rotary Temple for Weaving-Looms. By GEORGE DRAPER, Palmer, Mass. Oct. 28th.

CLAIM.—Having thus described my improvements, I shall claim as my invention forming two concentric rows of oblique teeth upon the wheel of a "rotary temple," the arrangement being substantially in the manner and for the purpose above set forth.

Improvement in the Machine for Cleaning Wool from Burs and other foreign matter, and also for ginning Cotton. By MILTON D. WHIPPLE, East Douglass, Mass. Oct. 28th.

CLAIM.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner of applying and using the vibrating doffer, with its comb plates, constructed and operating as herein set forth, in combination with the toothed guard-plate as described; and this I claim, whether the respective parts be formed exactly as herein represented, or in any other which is substantially the same, producing a like result by analogous means.

Improvement in the Machine for cutting Shingles. By MILES R. PAYNE, Andersontown, Indiana. Oct. 30th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the arrangement of the sliding dogs for holding the shingle bolt so as to take the weight from the knife as it passes through it, in combination with the cams on the sides of the sash for drawing the dogs from the bolt at the moment when it is required to descend for a new cut, all as before described.

Improvement in the manufacture of Gaiter Boots, by the introduction of Gum-Elastic Gores. By JOHN H. DUPONT and THEODORE HYATT, New-York. Oct. 30th.

CLAIM.—What we claim, therefore, and desire to secure by letters patent, is *not* the mechanical process by means of which shirred-faced materials and lining and india-rubber springs are *put* together; nor do we claim the mechanical means by which said shirred-faced materials and lining and india-rubber springs are *held* together; nor do we claim the said shirred-faced materials and lining and india-rubber springs, either separately or combined together, so as to form an elastic gore, substantially as aforesaid; nor do we claim said shirred-faced materials and lining and india-rubber springs, either separately or combined together, with or without their edges so prepared, secured or consolidated as aforesaid, as we are taking the necessary steps to secure this by a patent; nor do we claim the invention of a gaiter boot, constructed with an elastic gore; but we do claim as our invention, gaiter boots made elastic, substantially as aforesaid, by being constructed with an elastic gore or gores, made from the combination of shirred materials and india-rubber springs, substantially as above described.

Improvement in the Machine for cutting Corks. By CHARLES R. MACY, Hyde Park, N. Y. Oct. 31st.

CLAIM.—What I claim as my invention, and for which I desire letters patent, are:

1. The combination of the rotary cutter with the sharpening rotary disks, one on each face of the rotary cutter, for the purpose and in the manner described.

2. The method of moving the rotary cutter wheel up and down at the commencement and end of every operation, by means of the sliding frame $T_{''}$ $T_{''}$ acted upon by the cams T'' T'' for the purpose and in the manner described.

3. The method of feeding the machine with the block by means of the slide and jaw, in combination with the receiving box and spindles, as herein described.

Improvement in the mode of clearing Snow from Railroads. By JOSEPH H. MOORE, Worcester, and BENJAMIN WOODWORTH, Boston, Mass. Oct. 31st.

CLAIM.—The inventors claim as their invention, and ask a patent for the machine above described, consisting of the cylinder or drum, with its shaft, as above described, with the spiral plates or snow clearers, constructed and attached to the drum, as above described, with a crank or gear wheel for driving or propelling the machine as above described, in connection with a railroad engine, for the purpose above described.

Improvement in the mode of preparing Tallow for the manufacture of Candles. By JOHN KIRKMAN, N.Y. Oct. 31st. (Antedated July 2d.)

CLAIM.—What I claim as my discovery and invention, is the method of separating the oily part of the tallow by means of setting the mass of tallow over water as above described, and drawing off the water and oil from the bottom.

Improvement in Machines for separating Garlic from Wheat. By JONATHAN F. BARRETT, North Granville, N. Y. Oct. 31st.

CLAIM.—What I claim as constituting my invention, and desire to secure by letters patent, is the acting upon the grain by compression and attrition combined, with a force sufficient to crush the garlic and other foreign matter, without breaking the grain itself, the same being effected in the manner herein set forth; that is to say, by making pressure upon the grain subjected to attrition, either by means of a plate constructed as herein described, and revolving above it, and carrying agitators which coöperate with fixed agitators, as set forth; or by making the pressure by means of a column of the grain of sufficient height to effect the purpose, when combined with its agitation, by means of revolving and fixed agitators, arranged and operating substantially as herein set forth.

Improvement in the mode of protecting Trees from the Canker Worm. By DANIEL NEWHALL, Lynn, Mass. Oct. 31st.

CLAIM.—I shall claim as my invention, a roof or casing, constructed substantially as above described, (viz. with sides projecting below the

bottom of the trough, two of which sides are moveable or capable of being raised) in combination with a metallic trough for oil or other liquid suited to the object; the whole being arranged substantially in the manner and for the purposes above set forth.

Improvement in the mode of applying Steam Power to Locomotives, &c. By JOHN ERICSSON, Sweden. Nov. 5th.

CLAIM.—What I do claim as my invention, and desire to secure by letters patent, is the propelling of a locomotive carriage by the combining of two semi-cylinders, each furnished with radial pistons, which pistons vibrate within them, said semi-cylinders being placed on a level with each other; and the shafts or axes of their radial pistons extending through the cylindrical covers in opposite directions beyond the sides of a locomotive carriage, and having crank levers attached to their outer ends, which crank levers are connected by suitable rods to crank pins on the driving wheels; the respective parts being combined and arranged substantially in the manner herein set forth.

I likewise claim the employment of the same apparatus for the driving of the propelling or paddle wheels of such vessels as are propelled by the power of steam; the general arrangement and operation of the respective parts being substantially the same with those by which the said combined semi-cylinders are adapted to the propelling of locomotives, with such variations of arrangement only as are required by the nature of the case, and as herein fully pointed out and made known.

I also claim the combining of the double acting semi-cylindrical air-pump with my double semi-cylinder steam-engine, constructed and arranged as herein set forth, said air-pump having a radial vibrating piston, and the self-acting valves *I* and *i*, and being arranged and connected with the other operating parts of the engine substantially as herein described.

Improvement in the mode of constructing of, and the mode of combining, Portable Ovens with Stoves. By EDWARD GOSSELIN, New-York. Nov. 7th.

CLAIM.—What I claim as new and of my own invention, and desire to secure by letters patent, is not the mere combination of a portable oven with a cooking stove, as this is not new, but the combining the oven with the stove, in the manner herein set forth, so that the draft from the stove shall pass up on one end of the oven, over the top and down on the opposite end into the common flue of the stove; that is to say, I claim the combination of an oven, constructed in the manner herein set forth, with any cooking stove adapted to receive it, and so regulated as to admit the draft either to pass over the oven and thence into the flue, without circulating over the oven; the whole being constructed substantially in the manner herein set forth.

Improvement in the manufacture of Trunks, for rendering them Water-Proof. By PETER GETZ, Lancaster, Pa. Nov. 7th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the method herein described of rendering trunks water-

proof, by constructing them with a screw-plate or lid, in the manner set forth.

Improvement in the mode of cooling "the Mash used in the Process of Distillation, &c." By ALLEN D. WARD, Minerva, Mason co. Ky. Nov. 7th.

CLAIM.—My claim is then in this instance for *combining* the serpentine pipes *(a) (a)* and the receivers *(e)* and *(k)* to the shaft of the ordinary mash rake, in order to cool mash speedily, in warm seasons, after the mere operation of mashing is accomplished.

Improvement in Printing Presses. By STEPHEN P. RUGGLES, Boston, Mass. Nov. 10th.

CLAIM.—I claim, a platen raised and lowered by the machinery arranged as above described, in combination with the moveable tympan plate on which the sheet of paper is placed, and the bed supporting the type with their faces downwards, the whole being arranged and operating together substantially in the manner and for the purposes herein explained and set forth.

I claim supplying the press with paper, and removing the same after it is printed (into a box m' fig. 6, attached to the tympan carriage) *by means of a vibrating table* g' h' (operated by a cam a' fig. 2, on the shaft n' figs. 4 and 6, and other machinery immediately between said cam and table) *in combination with a frisket* constructed as above described, connected to the frame gg of the tympan plate, and pressed down upon said plate by a spring j^2 k^2, and raised when the tympan carriage recedes with the printed sheet by means of a cam o' fig. 2, of the shaft n, through the intervention of a bar w' with a roller v' shaft y' and angular piece of metal a^2; the whole being arranged and operating together substantially as herein above explained and set forth.

I claim grooving or channeling the fountain roller or plate under the same, in the manner and for the purpose above mentioned.

I claim the particular combination of machinery for the lateral vibration of the distributing roller, said combination consisting of the pulleys v^2 on the shaft B, band w^2, pulleys x^2, rod y^2 z^2, lever a^3 b^3 c^3, rod e^3 f^3, shaft g^3, and distributing roller frame o^3, the whole being arranged and operating together substantially in the manner and for the purpose above mentioned.

Improvement in the manner of constructing and shifting the Switches used at Turn-outs on Railroads. By JESSE LA RUE, Bristol, Pa. Nov. 10th.

CLAIM.—I am aware that switches have been shifted by the motion of the cars running on the rails leading thereto, and I do not therefore claim this as making any part of my invention; but what I do claim, and desire to secure by letters patent, is the combination, in the manner set forth, of the switches, connecting rod, and the two levers, furnished with the curved metallic castings acting as a counterpoise to the weight of the switches, and acted upon by what I have denominated the operating power, whereby the switches may be shifted before they are re-

acted by the car, the same being effected by the car itself, when traveling in either direction, as set forth.

I also claim the leveling of the ends of the switches, and of the rails, for the purpose and in the manner above made known.

LIST OF ENGLISH PATENTS

Granted between the 30th of August and the 26th Sept. 1840.

William Daubney Holmes, of Cannon-row, Westminster, civil engineer, for certain improvements in naval architecture and apparatus connected therewith, affording increased security from foundering and shipwreck. Sept. 3; six months.

Thomas Horne, of Birmingham, brassfounder, for improvements in the manufacture of hinges. Sept. 3; six months.

James Bingham, of Sheffield, manufacturer, for certain improved compositions which are made to resemble ivory, bone, mother-of-pearl, and other substances applicable to the manufacture of handles of knives, forks, and razors, pianoforte keys, snuff-boxes, and various other articles. Sept. 3; six months.

William Freeman, of Millbank-street, stone merchant, for improvements in paving or covering roads and other ways or surfaces, being a communication. Sept. 7; six months.

Thomas Motley, of Bath Villa, Bristol, civil engineer, for improvements in apparatus and means of burning concrete fatty matter. Sept. 7; six months.

William Coltman, of Leicester, framesmith, and Joseph Wall, of the same place, framesmith, for their invention of improvements in machinery employed in framework knitting or stocking fabrics. Sept. 7; six months.

John Whitehouse, the younger, of Birchall-street, Birmingham, brassfounder, for improvements in the construction of spring-hinges and door-springs. Sept. 7; six months.

Samuel Parker, of Piccadilly, manufacturer, for improvements in apparatus for preserving and purifying oils, and in apparatus for burning oils, tallow and gas. Sept. 10; six months.

Mark Freeman, of Sutton Common, gentleman, for improvements in weighing machines. Sept. 10; six months.

Paul Hanninc, of Clement's Lane, London, solicitor, for improvements in the construction of governors or regulators applicable to steam-engines, and to other engines used for obtaining motive power, being a communication. Sept. 10; six months.

Charles Delbruck, of Oxford-street, gentleman, for improvements in apparatus for applying combustible gas to the purposes of heat, being a communication. Sept. 10; six months.

Edward John Dent, of the Strand, chronometer maker, for certain improvements in clocks and other time-keepers. Sept. 10; six months.

Henry Houldsworth, of Manchester, cotton spinner, for an improvement in carriages used for the conveyance of passengers on railways, and an improved seat applicable to such carriages and other purposes. Sept. 10; six months.

Hugh Lee Pattinson, of Bensham-grove, Durham, manufacturing chemist, for improvements in the manufacture of white lead. Sept. 10; six months.

George Alexander Gilbert, of Southampton-buildings, gentleman, for certain improvements in machinery or apparatus for obtaining and applying motive power. Sept. 10; six months.

Robert Goodacre, of Allesthorpe, Leicester, for an apparatus for raising heavy loads in carts, or other receptacles containing the said loads, when it is required that the unloading should take place at any considerable elevation above the ground. Sept. 10; six months.

James Pilbrow, of Tottenham, engineer, for certain improvements in steam engines. Sept. 10; six months.

William Bedford, of Hinckley, Leicestershire, frame-work knitter, for certain improvements in machinery employed in manufacturing hosiery goods, or what is commonly called frame-work knitting. Sept. 17; six months

Henry Fourdrinier and Edward Newman Fourdrinier, of Hanley, Stafford, paper makers, for certain improvements in steam-engines for actuating machinery, and in apparatus for propelling ships and other vessels on water. Sept. 17; six months.

Moses Poole, of Lincoln's Inn, Middlesex, gentleman, for improvements in preparing materials to facilitate the teaching of writing, being a communication. Sept. 17; six months.

Walter Richardson, of Regent-street, gentleman, and George Mott Braithwaite, of Manor-street, Chelsea, gentleman, for improvements in tinning metals, being a communication. Sept. 17; six months.

Samuel Draper, of Nottingham, lace manufacturer, for improvements in the manufacture of ornamented twist lace and looped fabrics. Sept. 21; six months.

William Mill, of Blackfriar's-road, engineer, for certain improvements in propellers and in steam-engines, and in the method of ascertaining and measuring steam power, parts of which improvements are applicable to other useful purposes. Sept. 21; six months.

Charles Handford, of High Holborn, tea dealer, for an improved edible vegetable preparation called "Eupooi," and the mode of manufacturing the same. Sept. 21; six months.

Thomas Pain, jun. of Upper Seymour street, Euston Square, student at law, for a plan by means of which carriages may be propelled by atmospheric pressure only, without the assistance of any other power, being an improvement upon the Atmospheric Railway now in use. Sept. 22; six months.

John Maughan, of Connaught Terrace, Edgeware Road, gentleman, for certain improvements in the construction of wheeled carriages. Sept. 24; six months.

George Goodman, of Henley, near Birmingham, needle manufacturer, for certain improvements in the manufacture of mourning and other dress pins. Sept. 24; six months.

Thomas Muir and John Gibson, of Glasgow, silk manufacturers, for improvements in cleaning silk and other fibrous substances. Sept. 24; six months.

William Hirst, of Leeds, clothier, for improvements in the manufacture of woolen cloth and cloth made from wool and other materials. Sept. 24; six months.

Henry Pinkus, of Panton-square, Coventry-street, esquire, for improvements in the method of applying motive power to the impelling of machinery, applicable amongst other things to impelling carriages on railways, on common roads or ways, and through fields, and vessels afloat, and in the methods of constructing the roads or ways on which carriages may be impelled or propelled. Sept. 24; six months.

John Johnston, of Glasgow, gentleman, for a new method (by means of machinery) of ascertaining the velocity of a space passed through by ships, vessels, carriages, and other means of locomotion, part of which is also applicable to the measurement of time. Sept. 24; six months.

Pierre Erard, of Great Marlborough-street, for improvements in pianofortes. Sept. 24; six months.

Thomas Robinson Williams, of Cheapside, gentleman, for improvements in the manufacture of woolen fabrics, or fabrics of which wools, furs or hairs are the principal components, as well as for the machinery used therein. Sept. 24; six months.

Alexander Dean and Evan Evans, of Birmingham, millwrights, for certain improvements in mills for reducing grain and other substances to a pulverized state, and in the apparatus for dressing or bolting pulverized substances. Sept. 24; six months.

List of Irish Patents, granted for Sept. 1840.

Edward Thomas Bainbridge, for improvements in obtaining power.

W. Palmer, for improvements in the manufacture of candles and in apparatus for applying light.

Samuel Lawson, for improvements in machinery for spinning, doubling, and twisting flax, hemp, wool, silk, cotton, and other fibrous substances.

John George Bodmer, *(extension of term)* for certain improvements in the machinery for cleaning, carding, drawing, rooving, and spinning of cotton and wool.

Peter Fairbairn, for certain improvements in machinery or apparatus for heckling, combing, preparing or dressing hemp, flax and such other textile or fibrous materials.

Charles Wyh Williams, for improvements in the means of generating heat, principally applicable to the production of steam and the prevention of smoke.